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MASS. INSTITUTE OF TECHNOLOGY
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Western Electrician.

EVERY SATURDAY.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY. DEPARTMENT OF PHYSICS

VOLUME XXI.

NUMBERS 1—26

July 3 — December 25, 1897.

ELECTRICIAN PUBLISHING COMPANY,

CHICAGO.

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Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, JULY 3, 1897. No. 1

A Complete Electrical Printing Establishment.

One of the most interesting motor plants in Chicago has recently been started up in the Lakeside Press building, 149 to 155 Plymouth court. This plant is relied upon for the entire operation of the printing establishment of the R. R. Donnelley & Sons company, which now claims the honor of being the most complete electrically operated printing house in the West, and the only one (electrically equipped) in the country doing a general competitive printing business. There are in the East several electrical printing plants, but each of them is engaged in some special line of work and does not meet the open competition. Therefore the record of the Donnelley plant will be watched with interest, since it will demonstrate whether an electrically operated printing plant is able to turn out work more economically than one operated by belts and shafting. The Donnelley company made this departure from established practice only after a thorough investigation, and its action in this case shows its progressive spirit.

The interest in this installation, from an electrical point of view, is centered in its completeness and in the extreme conditions that had to be met regarding speed variation.

The power plant consists of two Stirling boilers, each of 150 horse power capacity and a 160 horse power Buckeye medium speed engine belted to a 100 kilowatt Western Electric dynamo (Fig. 1). The switchboard is provided with throw-over switches whereby current may be supplied to both motors and lights from the Chicago Edison circuits, in case it becomes desirable to do so. The generator is a 230 volt machine, and the three-wire system is used throughout the building, the neutral wire being connected through the switchboard to a small compensator. This outfit, shown at the left in the picture, consists of a 230 volt machine connected across the outside wires, directly coupled with a 115 volt machine connected to one of the outside wires and to the neutral.

Power is distributed through the building to 400 incandescent lamps, 30 enclosed arc lamps, two Crane electric elevators and 35 Crocker-Wheeler motors. Nineteen of the motors drive cylinder printing presses; six are individually belted to binding machinery, and twelve drive shafts to which are belted job presses and a variety of binding and book-making machinery. Four of the cylinder presses have slow-speed series motors directly connected to the driving shafts, while 15 of them are belted to individual compound wound motors.

Referring to the illustrations on succeeding pages, Fig. 2 shows one of the large presses in the basement, directly belted to a bipolar motor, while Figs. 3 and 4 show machinery in the bindery, the former being a view of a line of folding machines driven by a motor attached to boxed-in shafting on the floor level, and the latter showing a heavy "smasher" with an individual motor. In the large binding room, where there are many machines, the absence of overhead shafts and belting is particularly noticeable and advantageous.

Fig. 5 represents an electrically driven press where direct connection is used.

The nature of the work done on the presses varies widely, and as a result a variation in the speed of the presses from 600 impressions to 1,800 impressions per hour is necessary, and the armature speed of the motors is subject to a corresponding variation. The belted motors, therefore, run from 333 to 1,000 revolutions per minute. This speed variation is accomplished entirely by change of field strength and voltage, thereby permitting the motors to operate at a high efficiency throughout the entire range. Most of the machines in the bindery are grouped, and belted to short shafts placed on the floor, each shaft being boxed in to prevent accidents, and driven by a motor of suitable size.

THE LAKESIDE PRESS.

In adopting electricity as the motive power in this plant three main advantages were looked for—cleanliness, perfect control of machinery and economy of fuel. Each one of these expectations has been abundantly realized. The annual loss in paper spoiled by dirt, dust and oil dropping from the shafting and thrown by belts is a very material item in a printing establishment's expense account. The abolishment of overhead belting and shafting, by driving each press with a separate motor, and by putting such short shafts as are necessary in the bindery on the floor and completely covering them, entirely eliminates this source of expense, and actual results obtained show a saving of 1½ per cent. of the total amount of paper used. It will also be readily appreciated that the general light is very much improved by the omission of overhead belts.

The speed of the customary belt-driven printing press is altered by a four-step cone pulley, and to change the speed the press must be stopped and the belt shifted, thus losing time and shaking down dust. When the cone pulley will not give a slow enough speed the belt is shifted only part way over onto the tight pulley and so permitted to slip. This gives a speed that is unreliable and unsteady. As opposed to this crude method of control, the speed of the electrically driven press may, by simply shifting a lever, be altered at pleasure between much wider limits, as previously stated, and by from 34 to 48 steps, each step equaling between 30 and 40 impressions per hour. The facility with which the speed is altered and the small steps by which the alterations are made result in increasing the output of the presses per hour run, which is equivalent to a reduction both of wages and of general business expenses.

The saving of fuel by the substitution of motors for belting and shafting is a subject that has been so frequently and thoroughly discussed that there will be no need of going into the details of this particular case, but it is of interest to state that a saving of about 50 per cent. is being effected.

This entire electrical installation was in charge of Mr. Charles A. Pratt, consulting electrical engineer, of Chicago. It devolved upon him to devise a suitable method of speed control for the presses, to determine the best method of driving the presses and other machinery, and to get the plant into operation without delay or mishap.

The Lakeside Press building in which the plant is located was erected during the past winter. It is a thoroughly fireproof structure, stands 100 feet square on the ground and comprises seven floors and basement. It has light on three side and each floor is an open manufacturing space, free from partitions, and the excellent light and general cleanliness enable the proprietors to keep the best class of employes.

The proprietors are always ready to extend every courtesy to persons interested in electrical operation of factories who may wish to visit their plant.

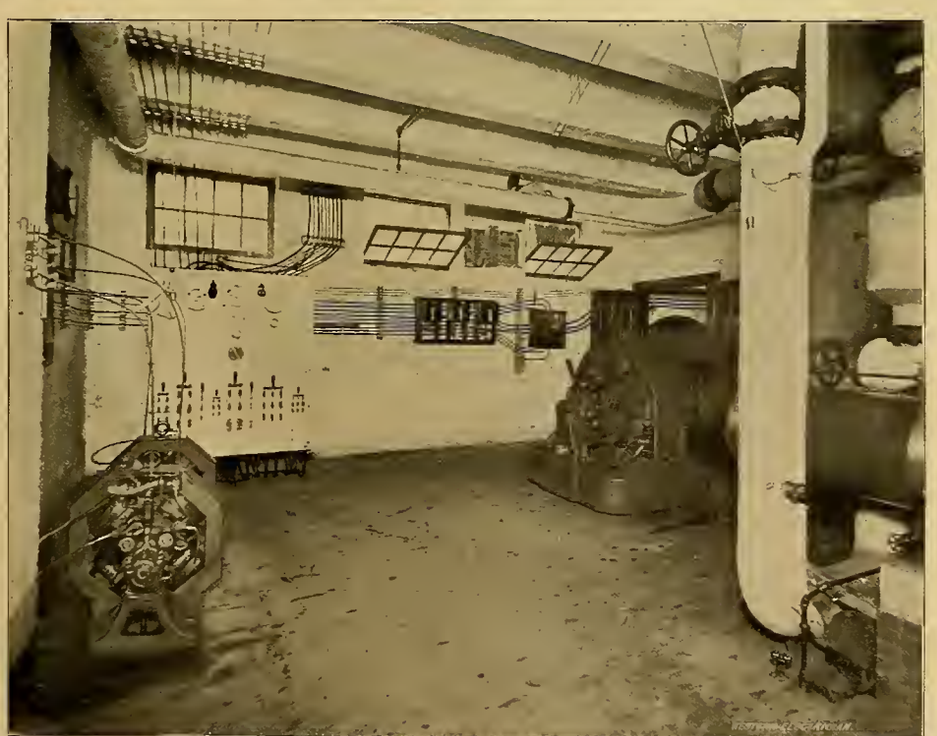


FIG. 1. A COMPLETE ELECTRICAL PRINTING ESTABLISHMENT.—ENGINE ROOM.

For the great naval review at Spithead last week the electrical stores included 215,000 yards of electric cable, 40,000 yards of small circuit wire, 25,000 16 candle power, 15,000 eight candle power, and 50 100 candle power incandescent lamps, besides a large quantity of electric light fittings.

Recent Progress in Arc Lighting.

By Elihu Thomson.

Part II.

In the use of "inclosed arcs" instead of "open arcs," one does not escape from the necessity of using in the branch with the lamp a choking resistance. A constant potential circuit of 45 volts will not supply current to arc lamps demanding 45 volts at the terminals and approximately the same at the arc. By the use of resistance in circuit, however, and sufficient additional potential, the current, otherwise "unstable," becomes "stable," and the arc stable. It is possible, indeed, with especially sensitive lamp mechanism, to replace a part of the resistance needed by inductance, and thus save some energy. The "inclosed arc" also demands a sacrifice of

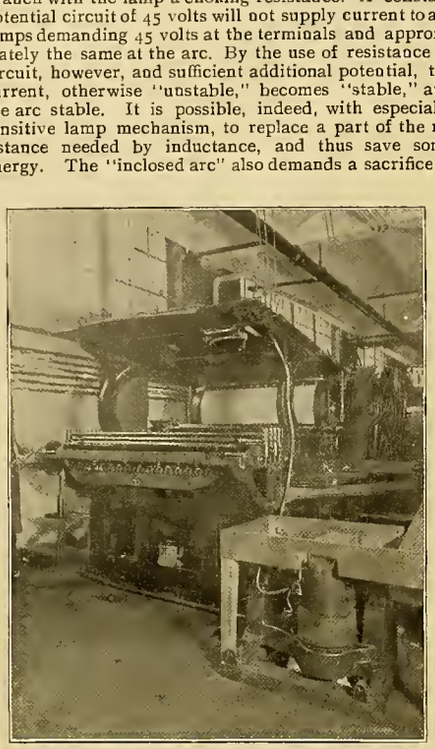


FIG. 2. A COMPLETE ELECTRICAL PRINTING ESTABLISHMENT.—MOTOR BELTED TO LARGE PRESS.

energy in resistance, for a circuit of 80 volts constant potential will not run 80 volt arcs.

For the purpose of discovering the minimum drop of potential required to exist over a dead resistance in circuit with arcs on constant potential mains, the writer instituted and had tabulated a series of tests in which the resistance in circuit with arc lamps was gradually cut down along with the line voltage, while the current and voltage of the arcs were maintained the same. A set of tests was made with two Thomson '93 lamps in series, using at one time plain National carbons, and at another a cored upper of one-half inch diameter, and solid lower carbon of one-half inch diameter. Also a set of tests was carried out with 80 volt inclosed arc lamps adjusted for currents of different amount at different times. During each test the line voltage was lowered and resistance cut out until instability of arc and current resulted, while up to that time the current and voltage of the arc were kept the same during the particular test.

The general result of these tests was as follows:

TWO '93 ARC LAMPS IN SERIES, WITH VARIABLE RESISTANCE.

One-half inch National carbons.

With 45 volts at each arc and a current of 9.6 amperes in the lamp branch, line voltage could not be reduced below 110 volts. This would give a drop of 20 volts over resistance and lamp magnets.

With 45 volts at arcs and 7.9 amperes, the limit was reached at 108 volts on the line.

With 46 volts at arcs and six amperes, the limit was 108 volts on the line.

TWO '93 ARC LAMPS IN SERIES, WITH VARIABLE RESISTANCE.

Carbons, one-half inch cored upper; one-half inch solid lower.

With 46 volts at arcs and 15 amperes current, the limit was 106 volts on line.

With 46 volts and 12 amperes, the limit was 104 volts on line.

With 46 volts and 9.4 amperes, the limit was 108 volts on line.

With 45 volts and 7.3 amperes, the limit was 104 volts on line.

With 42 volts at arcs and six amperes, the limit was 98 volts on line.

TEST OF 80 VOLT INCLOSED ARC LAMP, WITH VARIABLE RESISTANCE IN ITS CIRCUIT.

Solid upper and lower seven-sixteenths inch "Electra" carbons.

With 75 volts at arc and seven amperes, the limit of line voltage was 88 to 90.

With 74 volts at arc and six amperes, the limit of line voltage was 92 to 94.

With 75 to 76 volts at arc and five amperes, the limit of line voltage was 92 to 94.

With 78 volts and four amperes, the limit of line voltage was 98 to 100.

With 76 volts and 3.2 amperes, the limit of line voltage was 100. (Carbons, three-eighths inch "Electra.")

The above tests are, doubtless, sufficiently accurate to show the main point very clearly. This is that a certain line voltage as a minimum is absolutely necessary in working arc lamps on constant potential lines, whether they be open arcs or inclosed arcs. Thus, two 45 volt arcs in series, with uncored carbons like the brand known as "National," cannot be safely worked below 110 volts on the line with resistance in series with them. More than 110 volts should, of course, be maintained for safety of the service.

The tests show also that, with a cored upper carbon, the limit is lowered several volts on the average, and it is known that the voltage of the arcs may be safely reduced somewhat when cored positives are used.

It is also shown that a 75 to 80 volt arc, run upon a constant potential line, is stable at considerably less line voltage than the open arc. It would appear also that, with either open or inclosed arcs at ordinary current strengths of from five to 10 amperes, the steadying resistance in the branch is required to cause a drop of about 15 to 20 volts, or waste energy at the rate in watts of 15 to 20 multiplied by the amperes of current used in the lamp.

What the development of the art would have been if the voltage of our incandescent circuits was, as originally set, say 90 volts, instead of 110, is a subject for meditation.

With inclosed arcs on continuous current circuits, as with open arcs on similar circuits, the chief source of light is the positive crater, and the downward emission is, of course, favorable to their use in illumination. This tendency to throw light downward is, in the inclosed arc, modified by the diffusive action of the inner globe, which tends to scatter the light received by it in all directions—upward, downward and horizontally.

The running of single alternating current arc lamps on constant potential circuits is facilitated by the ease with which, by a transformer or compensator, the potential required for the lamp may be obtained. It was natural that, when arc lamps came to be used on constant potential, continuous current circuits, a demand for lamps which would work upon alternating circuits fed by transformer secondaries should arise. While in the direct current systems the potential was definite and practically could not be adapted to the lamp, in the alternating current case transformation was easy, as by the simple device of a compensator the line voltage could be raised or lowered to suit that demanded by the lamp. An arc lamp compensator is simply a laminated core bearing a coil divided into sections with connections carried out between the sections. If the self-induction of the coil is proportioned for the secondary circuit voltage in a transformer system, as for 110 volts at the ends of the coil, circuits of 30 volts may be obtained by taking three-elevenths of the turns as a secondary; that is, by connections which include between them any turns of the coil which equal three-elevenths of the total, or which give 30 volts. Moreover, several connections of the kind may be made to the same coil anywhere between its ends, provided that the wire included between the two connections for one lamp circuit is sufficient to give the requisite voltage. Further, the sections of wire thus chosen may overlap each other, and portions of the compensator coil thus appear to be doing double or treble duty. Whether the current be furnished direct from the secondary of a transformer or through compensators, the lines led to the lamps are of constant potential character, and the lamps have to be adapted thereto.

An alternating arc is peculiar and different from the continuous current arc in a number of important particulars. The fact that the arc is extinguished between successive alternations at the zero points of the current wave, and at a rate equal to double the periodicity, results in the musical sound of the arc, which may become a source of annoyance. The same cause gives rise to difficulty in starting the arcs without having them chatter, for until the carbons get strongly heated the arc is not re-established after extinguishment with the carbons separated. With cold carbons the carbons must touch each other after an extinguishment at the zeros. Hence, the carbons must be separated very slowly while a large current flows so as to strongly heat their ends, or a higher potential than that to be used in running the lamp after starting must be applied at first. Another way is to employ a resistance, or, better, a reactive coil in circuit with the arc lamp, so as to change the character of the potential at the lamp terminals, which then becomes less than that of a constant potential, and, in fact, begins to approach, in a measure, constant current supply. But in the use of a resistance or reactance in circuit with the lamp, it is, of course, necessary to increase the potential of the line accordingly, so as to give the proper potential to the arc, while both expedients involve a loss of energy. It is found not to be practicable to run alternating arc lamps on circuits much below 40 cycles. The common rates of 60 and 125 are well adapted to the case.

The efficiency of the alternating arc as a source of light has been shown by Prof. A. E. Blondel, in a recent paper, to be quite variable. It depends on the length of arc used with the particular carbons employed, and on the diameter of the carbons as with continuous current. It also depends on the form of the wave of the alternating current. It was found that with a rectangular wave alternating current, such as may be produced by reversing a continuous current by a commutator, the light given out was as 79 to 59 in the case of sine wave currents. This should follow from the fact that the extinctions, as Blondel pointed out, were instantaneous in the first case, and lasted for about one-quarter of an alternation in the case of the sine wave,

The writer takes occasion to express the opinion that with very flat-topped waves, or waves approaching closely to rectangular waves, the limit of periodicity would be found far below 40 per second, as regards the maintenance of an arc. If the reversal or passage through zero is quick enough, almost any reduction of periodicity would become possible. There are, however, practical considerations which set the limits in such a case.

Soft carbons, or those best suited to readily furnish considerable volatile matter, seem to be best adapted to alternating current arcs, and they are frequently cored. The color of the light suffers some in consequence.

The distribution of light from an alternating current arc with vertical carbons, owing to the fact that the chief light source—the positive crater—is on the upper and lower carbon alternately, is both downward and upward. The upward radiation, except in rooms with white walls or ceilings, or with lamps provided with shades or globes of a strong diffusing power, would be lost except for the employment of deflectors or reflectors immediately above the arc, which catch a fair proportion of the rays and send them downward. The lamp in this case is made focusing, so that the arc will always be kept burning but a short distance below the reflector plate, which is made with a heat-resisting, white enameled surface.

A moment's consideration will show that under no circumstances can an alternating arc give out as much light for a given expenditure of energy as does a continuous current arc for the same expenditure. The light comes mainly from the positive crater, whose temperature and consequent luminosity is limited by the vaporizing point of carbon. The positive crater from which the current passes to the arc is much larger and much hotter than the negative spot on the opposite carbon receiving current. If, now, there is a rapid interchange or reversal of current and dead points or zeros between the reversals at each alternation, the positive crater has to form anew upon a surface which, while negative, was, on the average, far below crater temperature, having cooled during the time it was negative, and during the zero or period of extinguishment. It results from this that the average temperature of the light-emitting surface of carbon in an alternating arc is below that of the vaporization temperature of carbon, and the emission of light consequently lessened. It is known that the light emitted from a hot surface as temperature rises increases far more rapidly than the temperature or total radiation.

The shape of the wave of current has a great influence on the conditions of temperature just pointed out, and the rectangular wave must necessarily approach in its efficiency more nearly that of continuous currents than a peaked wave with longer zeros.

The use of single arcs across alternating constant potential mains requires only that the lamp mechanism be operated by variations of the current passing the arc. Hence, an electro-magnet in series is used to lift and feed the carbons, or sometimes the expansion of a high-resistance wire, traversed by the lamp current, has been applied for the same purpose, as in the "Kester" lamp. The electro-magnet is open to the objection that its

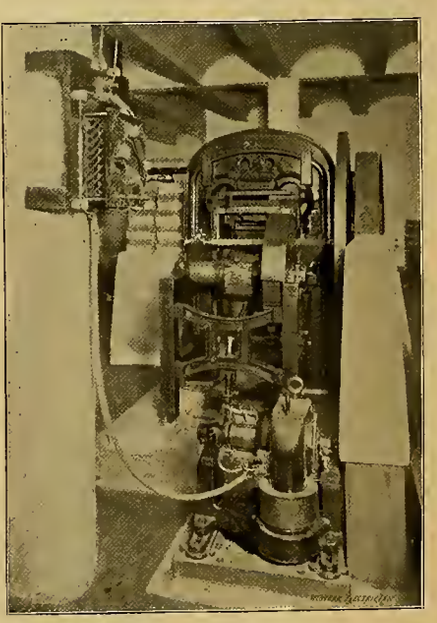


FIG. 4. A COMPLETE ELECTRICAL PRINTING ESTABLISHMENT.—"SMASHER" IN BINDERY DRIVEN BY MOTOR.

action is so instantaneous as to be liable to provoke chattering at starting, requiring a carefully adjusted check or dash-pot to prevent such action, and the magnet armature, or core, may also, unless very carefully arranged, produce by its inevitable vibrations a harsh note audible some distance away. Add this to the hum of the arc itself, and it is easy to see that such a lamp may become intolerable indoors in a quiet room. In the use of a hot wire the objection of chattering at the start is overcome without difficulty, and the wire is noiseless in its action; but it demands that considerable energy be wasted in it, and hitherto the temperature at which the wire must be run to secure sensitiveness of feed or rapid heating and cooling, following variations of current, has been such as to endanger its permanence or cause it to

oxidize. If the arc requires 28 to 30 volts, and the regulating wire five to seven volts, it is easy to see that a considerable sacrifice has been made for the result attained, particularly as in the use of hot wire over-feeding is liable to take place. The writer obtained, a considerable time ago, a much better result by using the hot-wire principle, but variably shunting it by a set of contacts controlled by a small electro-magnet in series relation, which addition imparted greatly increased sensitiveness, while the slow start given by the hot wire was still secured.

It is well known that in practice an alternating current arc often starts readily with new carbons, the trouble of chattering appearing when a new arc is to be started with carbons which had before been heated or used. This difference is owing to the fact that in the latter case the high temperature of the arc had driven out the gases and volatile materials which, as present in the ends of the new carbons, facilitate the formation of flame or lower the resistance of the arc at starting. By dipping the ends of the used carbons in a solution of some salt for a moment, the required volatile matter may be furnished to them so that they will start as readily as the new carbons.

The arc in the ordinary alternating current arc lamp appears to be stable, even when the connection is made across constant potential mains without resistance or reactance in the branch as a check upon the current. Therefore, nearly all the energy may be thus delivered to the arc itself without deduction. This fact tends to neutralize the lower efficiency of light production in the alternating arc, since the continuous current arc on constant potentials involves a dead resistance loss. Any comparison, then, must, for practical purposes, consider the total energy used in the branch in which the lamp exists, and the light produced or emitted in directions permitting utilization.

While the alternating arc, run from constant potentials, is feasible, the difficulty of chattering and large variations of current at starting results from the arrangement, and any sudden fall of potential may cause a momentary extinguishment. Particularly is this the case when the arc is of the "inclosed," long-burning type. In such case, on account of the greater length of the arc, it is peculiarly sensitive to influences which would affect but slightly the ordinary open-air arc. With the open-air arc a comprehensive set of tests made under the writer's supervision disclosed the fact that various makes of carbon gave widely different results. It was found that the length of arc or separation of the carbons for a given potential was, under equivalent conditions, quite variable, and the curious fact was noted that with some makes of carbon the variation of arc length with variations in the potential of the circuit supplying the lamp were much less than with certain other makes. Some gave excessive variation of arc length with moderate variations of potential at the arc, while others gave only moderate variations of arc length for considerable variation of potential at the arc. Of course, the latter are far the most desirable carbons for practical use. The results in each case were plotted as a curve, and comparison and superposition of the curves showed the superiority of one or another brand. The curves showed also the arc length for each kind of carbons for a given potential across the arc, which it was important to know in selecting carbons best adapted for alternating current work. The carbon which gave the longest arc at the lowest potential, and one which did not vary its length as much or more than that obtained with other carbons for certain variations of potential, would practically be preferred, other things being equal. It is too early to predict what part of the "inclosed" alternating arc may play in the future art of arc lighting, but it probably will find a considerable application.

When an alternating arc is run with a considerable dead resistance in series with it, or when a reactance coil is in series, or when it is fed from the secondary of a leakage transformer, taking the whole current thereof, the condition approaches, though in cases only imperfectly, the running of the lamp on approximately constant current. In reality, the condition is intermediate between constant current and constant potential working. In such a case the regulation of the lamp may be by a series magnet, or a shunt magnet, or by a combination of both. In fact, there is no real utility in generating a constant current of alternating character for working a single lamp. The utility of the "intermediate" working, just alluded to, is in the lessened liability to rupture of arc, lessened chattering at starting, and avoidance of excessive flux of current if the carbons, by accident, come together. The condition is one decidedly useful in the case of the "inclosed arc" of alternating type, and it is doubtful if such arcs can be run, except under conditions like those here called "intermediate." For saving energy a reactance or reactive coil in the lamp circuit is preferable to a dead resistance, and is relatively more effective.

It may be well to add to the present paper, which has grown to unexpected length, a statement concerning the results arrived at by innumerable tests of the different types of arcs and arc lamps under conditions resembling those of practice, with a view of ascertaining their lighting values. These tests have been embodied in comprehensive reports by Jesse Coates of the testing department of the General Electric company at Lynn, and the tabulated results might easily furnish material for a lengthy discussion. They embody complete series of measurements of candle power in various directions, and curves of the same for each kind of arc or condition of surrounding globe, together with mean spherical and estimated useful illuminating intensities. The methods of measurement can not be detailed here, but are such as, in the writer's judgment, can be relied upon to give comparative figures. Moreover, the mean of many observations is, in each case, taken for comparison and plotting of curves.

The purpose here shall be to state, in a general way, some of the results obtained.

It is well known that the larger the arc, or the larger the current in it with a normal voltage, the more efficient is the light production. The energy is more effectively converted into luminous waves, so that the watts per candle would naturally be less with a 20 ampere arc at 48 volts than with 10 amperes flowing. Measurement shows that where, with continuous current, the same brand of hard carbons is used of diameters varying approximately with the current strength, naked arcs, with 10 amperes and 48 volts, may take for each mean spherical candle power 1.2 watts, while arcs of seven amperes and 48 volts require 1.4 watts.

The use of a cored upper carbon appears to raise the efficiency to a moderate extent, probably because the arc may be maintained at a voltage somewhat less, as at 42 or 44 volts. The use of a clear globe surrounding the arc loses 10 to 12 per cent. of the light, while alabaster and opal globes lose from 45 to 65, according to their thickness and the specific absorptive power of the glass. Naturally, since an inclosed arc, consuming approximately the same energy in watts at the arc as a 10 ampere open arc, will have a current of only about 7½ amperes, the efficiency would be expected to be less. Measurements show, after a run of 102 hours, and per each mean spherical candle power of 4¾ amperes inclosed, continuous current arc with clear inner and no outer globe (one-half inch carbons), an expenditure of 1.94 watts at the arc. If the energy expended in the lamp branch be taken as the true expenditure, that lost in resistance is added to that of the arc, and the watts per candle increased accordingly. A similar loss is, of course, experienced with naked or open arcs on constant potentials, owing to resistance being used in series. The result given above, or 1.94 watts per candle, is at the end of a long run of 102 hours, but with a clear inner globe. Inclosed arc lamps with clear inner and clear outer globes are not satisfactory, and, in fact, for good results of uniformity and diffusion, a slightly opal inner globe is needed. Those now known as "alabaster" are well suited to the purpose. When these are used, the watts at the arc per mean spherical candle power will at the first part of a run, range about two watts, increasing seriously only towards the very end of the run. While it may seem that the watts per candle are higher than might be expected, yet it must be borne in mind that in all inclosed arcs the current is relatively small and the potential high for a given expenditure of energy, and this acts in a double way to lower the efficiency, as not only the crater emitting light is smaller, but a large part of the energy goes to sustain the arc flame, which is long, while, also the absorption of light by the surrounding glass is not to be neglected. No construction of lamp, regulation or adjustment thereof can get rid of the inherent properties here pointed out. Nevertheless it is true that the character of the light, both of the open or exposed arc, and of the inclosed arc, is such as to make it very desirable as a substitute for daylight and for many cases of use. The fact that the light is shed mainly downward by continuous current arcs results virtually in an addition to the efficiency and economy of the light; thus, if the light emitted downward be considered as alone useful, the expenditure per mean useful candle would, with naked arcs, fall to about one-half a watt, and with inclosed arcs, to from one to 1½ watts at the arc.

With alternating arcs the conditions are different, since the light is sent up and down equally. By a reflector placed above the arc, a considerable fraction of the light which would often be lost upward is sent downward to increase the effectiveness; thus, a 16 ampere 25 volt, naked alternating current arc used, per mean spherical candle, 1.49 watts, or for mean useful below the horizontal, 1.12 watts, which was reduced to .8 to .9 watt when a porcelain reflector above the arc was used. For the same causes that necessarily reduce the efficiency of an inclosed continuous current arc as compared with the uninclosed, the efficiency of an inclosed alternating arc falls below that of the open arc with similar currents. The watts at arc per candle will be found, per mean spherical candle, to be, under the best conditions, about two watts, increasing toward the end of the run, owing to obscuration of the inner globe and other causes. No reflector or deflector can be used with much effect with the inclosed arc, so that the mean useful is but little different from the mean spherical candle power.

The apparent advantage in economy of the continuous current inclosed arc over that with alternating currents is in large measure neutralized by the fact of the former requiring a dead resistance in circuit to give stability to the current, while the latter can be run without it, or, at most, with a reactive coil, which wastes but little energy.

Still, it must be confessed at the end, that the luminous yield is but little better than that obtained in incandescent lighting. After all, it may be that the whiteness of the light and the daylight effect obtained may be a sufficient reason for the large introduction of inclosed arcs, now that the frequent trimming and attention to the lamp is not needed. Indeed, it may also appear that all the varieties of arc lighting which have grown into importance within the past few years have their own fields of usefulness, and that, therefore, the work spent in developing them has not been labor in vain.

It should be said, in conclusion, that the figures given above, and expressing the watts per mean spherical candle, while strictly comparative so far as a study of arc lights alone is concerned, might vary somewhat if the object had been to compare arc and incandescent lights, owing to the difference in color of light, though the variation would not in any case be great.

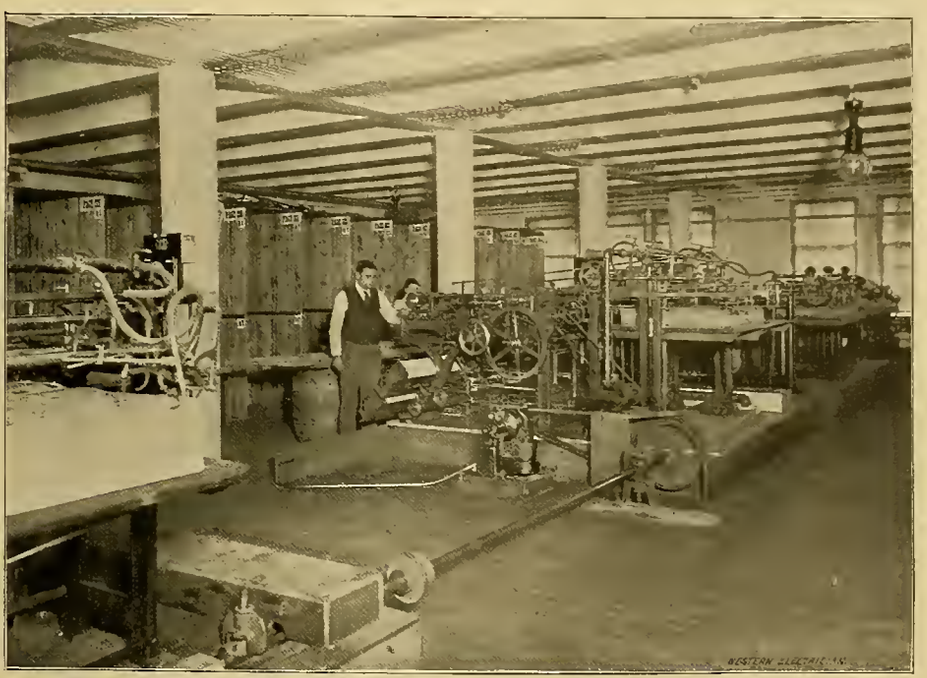


FIG. 3. A COMPLETE ELECTRICAL PRINTING ESTABLISHMENT.—ELECTRICALLY DRIVEN FOLDERS IN BINDERY.

Siemens & Halske Electric Company.

At the annual meeting of the Siemens & Halske Electric company of America the following-named directors were elected: W. L. Elkins, Jr., Martin Maloney, B. W. Grist, C. T. Yerkes, C. E. Yerkes, R. S. Grant, E. T. Rice, Jr., W. P. Butler and F. W. Whitridge. Officers were chosen as follows: President, C. E. Yerkes; vice-president and treasurer, W. F. Furbeck; secretary, F. B. Badt; assistant secretary and assistant treasurer, W. T. Block. Charles T. Yerkes, W. L. Elkins, Jr., and B. W. Grist replace W. F. Furbeck, A. W. Wright and D. B. Lyman in the directorate.

The new names indicate that Mr. Yerkes and his old associates in Philadelphia will hereafter take an active part in the conduct of the business. Mr. Elkins is a son of W. L. Elkins, Sr., who was closely associated with Mr. Yerkes in the Philadelphia street railway syndicate. B. W. Grist is now general manager of the Pennsylvania Iron Works of Philadelphia, and he has also been made general manager of the Siemens & Halske Electric com-

pany. This action was taken in anticipation of the consolidation of these corporations. The following self-explanatory letter has been sent to the stockholders of the Siemens & Halske company by D. B. Lyman, C. T. Yerkes and R. S. Grant, the committee in charge of the consolidation:

The Pennsylvania Iron Works company of Philadelphia, Pa., has made a proposition to the stockholders of the Siemens & Halske Electric Company of America, and the majority of the stockholders of the latter company have already accepted the proposition and will exchange their stock at an early date.

At the annual meeting the undersigned were appointed a committee to communicate with individual stockholders with reference to the proposition of the Pennsylvania Iron Works company, and to arrange the details of the exchange of stock in behalf of any of the shareholders who may desire to avail themselves of the offer.

The proposition of the Pennsylvania Iron Works company (whose capital is $1,750,000 preferred and $1,500,000 common stock) is to exchange one million dollars of its preferred six per cent., non-cumulative stock, and one million dollars of its common stock, so far as the same may be available by reason of the acceptance of the proposition by the shareholders of the Siemens & Halske Electric company of America, on the following basis:

Each shareholder of the preferred stock is to receive $1\frac{3}{10}$ shares of preferred stock of the Pennsylvania Iron Works company in exchange for his preferred share in the Siemens & Halske company.

Each shareholder of the common stock of the Siemens & Halske company is to receive $\frac{3}{10}$ share of preferred stock and $\frac{1}{10}$ of common stock in the Pennsylvania Iron Works company.

The chairman of this committee is D. B. Lyman, 100 Washington street, Chicago, and is authorized by this committee, and by the Pennsylvania Iron Works company, to receive for exchange the shares of the Siemens & Halske company for the stock of the Pennsylvania Iron Works company.

The proposition of the Pennsylvania Iron Works company is open for 60 days from the 17th of June, 1897, and is regarded as a desirable proposition for the shareholders of the Siemens & Halske company, and should be availed of at once by those who desire to exchange their stock.

Please to send your stock, for the purpose of exchange, to D. B. Lyman, 100 Washington street, and he will issue a receipt for your stock to be exchanged, or for a return in case the stock for any reason is not issued.

All persons desiring further particulars can obtain the same from any member of this committee.

The Pennsylvania Iron Works is one of the strongest corporations in its particular line in the country, and it is believed that a consolidation with that company will result advantageously to the Siemens & Halske company.

Northwestern Convention at La Crosse This Month.

The fifth semi-annual convention of the Northwestern Electrical association will be held at La Crosse, Wis., commencing on Wednesday morning, July 21st. All interested in electrical matters, whether members of the association or not, are invited to attend this meeting. The Cameron Hotel will be official headquarters, and the Hotel Law and Hotel Bronson will also accommodate delegates. One hundred and ten volt direct and 7,200 volt alternating current, with abundant space, will be at the service of exhibitors. Address F. A. Copeland, La Crosse, Wis., for hotel and exhibit accommodations. The Western Passenger association has granted a $1\frac{1}{3}$ rate, conditional, however, upon 100 certificates of attendance. Special sleepers on the Northwestern road will leave Chicago at 10:15 P. M. and Milwaukee at 8 P. M. on Tuesday, July 20th, running together from Madison via Elroy. Delegates from or through Chicago should apply for reservations to George Cutter, 1104 Rookery building, Chicago; those from or through Milwaukee to Secretary T. R. Mercein, 511 Montgomery building, Milwaukee. Papers on "Meter Tests," "220 Volt Lamps," "Use of Oil in Transformers," "Utilization of Exhaust Steam," "Evolution of the Incandescent Arc Lamp," "Rotary Transformers" and "Fuels for Central Stations" will be presented by Prof. D. C. Jackson of Wisconsin University, Prof. G. D. Shepardson of Minnesota University, Prof. R. B. Owens of Nebraska University, George L. Thayer of Iowa, O. M. Rau of Wisconsin, C. F. Scott of Pennsylvania and John C. McMynn of Illinois. The entertainment committee has arranged an enjoyable programme, including a river excursion and picnic lunch, trolley parties, etc.

An Enjoyable Trolley Party.

About 150 members and friends of the Chicago Electrical association enjoyed the delights of a trolley party over the lines of the Calumet Electric Street Railway company on the evening of June 25th. The host of the occasion was Mr. W. A. Harding, the master mechanic and electrician of the road, and he executed the agreeable duties of his position in a manner that met with hearty approval. The ladies and gentlemen filled three cars, and they all enjoyed themselves.

Westinghouse Company Secures a 75,000 Horse Power Contract.

The Westinghouse Electric & Manufacturing company, on Tuesday, June 22, 1897, declared a quarterly dividend on its preferred stock of $1\frac{3}{4}$ per cent.

On Wednesday the annual meeting of the stockholders took place at the factory of the company in East Pittsburg, Pa. The annual report was read, showing the condition of the company to be a prosperous one. The board of directors of last year was re-elected. It is composed of August Belmont, Lemuel Bannister, George Hebard, Henry B. Hyde, Marcellus Hartley, A. M. Byers, N. W. Bumstead, Charles Francis Adams, Brayton Ives and George Westinghouse, Jr.

After the meeting announcement was made to the stockholders of the company that the largest contract for electrical apparatus which has ever been given out had been secured by the Westinghouse Electric & Manufacturing company on June 19th. This is from the St. Lawrence Construction company of New York, and calls for fifteen 5,000 horse power generators, which are to be erected at the plant at Massena, northern New York, on the St. Lawrence River. This is the largest single order ever given for electrical apparatus, and the amount directly involved is about three-quarters of a million dollars.

This contract, together with that recently given by the Cataract Construction company of New York for five 5,000 horse power generators for installation at Niagara Falls, N. Y., makes a total of twenty 5,000 horse power generators, having a total capacity of 100,000 horse power, which have been ordered from the Westinghouse Electric & Manufacturing company this year. The five generators for Niagara Falls are well under construction, and the other 15 required by the St. Lawrence company will be immediately proceeded with, and their construction will give employment to a large number of men. These orders cover only the apparatus for generating electricity, and there will necessarily be required other apparatus of equal capacity for the utilization of the electrical energy produced by these great generators, and the Westinghouse officials expect that a large proportion of the additional apparatus will be ordered from their company by reason of their having already secured the contract for the principal apparatus. The placing of these recent important contracts has undoubtedly resulted by reason of the success of the three 5,000 horse power generators already installed at Niagara Falls, coupled with the fact that the Westinghouse Electric & Manufacturing company has exceptional facilities for turning out large machinery.

Central London Underground Electric Railway.

The most recent addition to the system of underground railways with which London is provided, and the most important of all the present undertakings of a similar character in the world—the Central London railway (underground)—has an especial interest for Americans. This is due to the fact that the entire system of electrical equipment will be American manufacture. With the exception of the elevators the entire electrical contract has been assumed by the British Thomson-Houston company, representing in Great Britain the General Electric company of Schenectady, N. Y., while the elevator contract has been secured by Frank J. Sprague of New York.

The road, laid in two deep subway tunnels, driven by the Greathead shield, stretches from Liverpool street, beneath the station of the Great Eastern Railway company, near Broad street, the city terminus of the North London railway and the Bishopgate street station of the Metropolitan underground railway, through the very center of the great commercial district of the city, as shown by the accompanying map, and runs due west under Holborn, High Holborn, Oxford street and past Hyde Park as far as the generating station located at the terminus at Shepard's Bush. It follows the line of greatest traffic in London. The road will receive passengers from the great underground central depot, now in course of construction by the Central Railway company, between the Bank of England and the Royal Exchange, passengers brought in by the main lines of the London & Northwestern, Midland and London & Southwestern railroads. It is especially at this point in the city that street crossing is a perilous task, and the railroad company is now engaged in constructing a series of subways immediately below the surface for the convenience of pedestrians and as approaches to its own station below. From this central depot will radiate not less than five underground tunnels, some 85 feet below the surface, each feeding a separate and populous district of the great city.

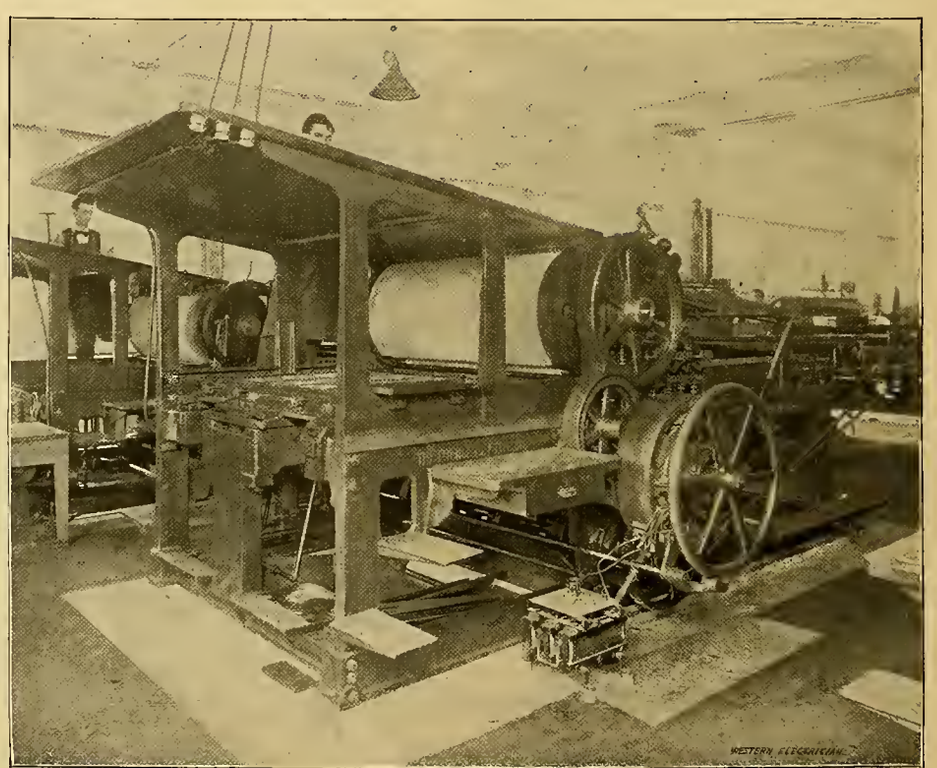


FIG. 5. A COMPLETE ELECTRICAL PRINTING ESTABLISHMENT.—DIRECT-CONNECTED MOTOR AND PRESS.

The construction of the road itself has been carried out by the Electric Traction company, which has also financed it. It is this company that has made the contracts with the British Thomson-Houston company, and which will turn over the road fully equipped and in working order to the Central London Underground Railway company ready for operation.

It was not until three years after the necessary parliamentary act was passed in 1893 that the actual work of building this road could be undertaken. Vertical shafts were driven at six different points to a depth of between 60 feet and 70 feet and the tunneling was begun in four tunnels at once, two running in each direction from the shaft. At each of the stations were driven two shafts 23 feet in diameter and 87 feet deep and one 18

feet in diameter and 76 feet deep—the two former containing two ingress and two exit elevators and the smaller two spiral stairways, one for ascending, the other for descending passengers. The shafts are built up of cast-iron plates 1⅛ inches thick and 4½ inches in the flanges. All crevices in the back of the plates are filled with hydraulic lime grout injected under pressure.

The glazed white brick passages leading from the bottom of the shafts to the stations are eight feet three inches wide on the entrance side. On the exit side, where crowds might collect in front of the elevators, they are 13 feet wide.

At the stations the widened tunnel is 21 feet in diameter, and 375 feet long. The main tunnels are each 11 feet six inches in diameter, and are practically steel tubes driven forward through the clay. The plates used to line these tunnels are seven-eighths inch thick with flanges four inches deep. The shield for driving the small tunnel was 12 feet eight inches in diameter and was pushed forward by six hydraulic rams giving a pressure of 230 tons. For driving the station tunnels the shield was 23 feet eight inches in diameter and was pushed forward by 22 rams giving a pressure of 840 tons.

Each tunnel will contain one track, one tunnel carrying the east-bound trains, the other the west-bound trains. In laying the roadbed, the best modern steam railway practice has been followed. The steel rails weigh 100 pounds to the yard and are laid upon heavy cross-ties. The system of contact will be third-rail, with the contact rail placed between the service rails of the track and well insulated. The conductors will be fed at intervals from a copper feeder cable. This feeding will be controlled from the signal boxes, and the operator will be able to cut out any section of the line when necessary. This method of contact is similar to that employed so successfully by the General Electric company in the installations on the East Weymouth, Nantasket Beach and Berlin-Hartford branches of the New York, New Haven & Hartford railroad. The method of traction, however, will differ radically from that used on the branches above mentioned. Instead of passenger-carrying motor cars, with the motors mounted on the forward axle, locomotives similar in appearance to those used on the Belt Line tunnel service of the Baltimore & Ohio will be used to haul the trains. The reason for this lies in the fact that the tunnel is only 11½ feet in diameter and that the bottom of the tunnel must accommodate the road bed. This materially reduces the clearance. The motors require to be suspended between wheels at least 30 inches in diameter to give the necessary clearance between them and the ground, and this fact has brought about the locomotive in place of the passenger motor car.

The total length of the road is 6½ miles from the station at Shepard's Bush to the Mansion House, or 13 miles of single track. There will be 14 stations, including the termini, located at the following-named points, running east from Shepard's Bush: Holland Park, Notting Hill Gate, Queen's Road, Westbourne, Marble Arch, Marylebone Lane, Oxford Circus, Tottenham Court Road, the British Museum, Chancery Lane, Holborn Viaduct, the Mansion House and Liverpool Street. In designing the line a decided departure has been made in the arrangement of the station approaches. As the railway company is not embarrassed by any considerations of grade, as in the case of surface railroads, the plan is adopted of making the road act as an auxiliary to the operation of the trains as well as merely to carry them. On each side of each station is a three per cent. gradient rising on the approaching side, and falling again to the level of the road on the departing side. This method gives a retarding effect to all trains approaching the stations equivalent to the application of considerable braking power, while materially aiding in the acceleration of all trains as they leave the platforms. Furthermore, the saving in power necessary to secure the requisite rapid acceleration is, by the adoption of this plan, calculated to amount to about 33 per cent.

The schedule speed of the trains will be 14½ miles an hour, with stops at each station of 20 seconds. The trains will be run at first under a headway of 2½ minutes, which will be reduced as soon as the traffic demands to a headway of two minutes.

The generating station will be located in the open air, at the extreme western end of the line near Shepard's Bush station. In building this the most modern American methods will be followed. The steam will be supplied from Babcock & Wilcox boilers, and the engines, of which there will be six, will be horizontal Allis machines, each of 1,300 horse power.

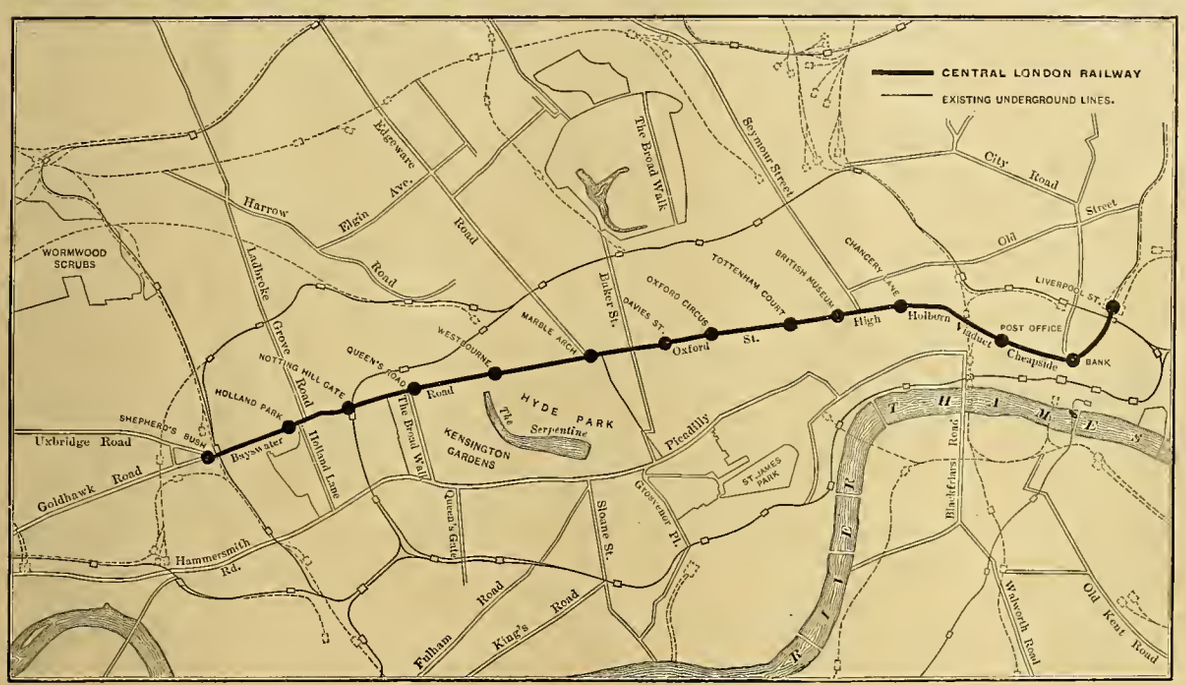
The electrical system adopted is the three-phase alternating high voltage primary, with reducing transformers and rotary converters, similar in general principle to that installed successfully by the General Electric company for the roads between Lowell, Mass., and Nashua, N. H., and at Portland, Ore., between Niagara Falls and Buffalo, and on the line between Dublin and Dalkey, in Ireland.

There will be six dynamos, and each will be directly driven by its own engine. These dynamos are of the newly developed rotating field and stationary armature type. Each will have a capacity of 350 kilowatts. The speed of revolution will be 94, the frequency 25 cycles, and the initial electromotive force 5,000 volts. The total capacity of the power station will be 5,100 kilowatts or 6,800 horse power.

From the switchboard the current is carried to the converter sub-stations, of which there are four. Two of these will contain seven step-down static transformers, six for service and one in reserve, each of 300 kilowatts capacity, and two rotary converters, each of 900 kilowatts capacity. The other two stations will contain four 300 kilowatt static transformers and one 900 kilowatt rotary converter. In the transformers the voltage of the current will be reduced from 5,000 to 330, at which pressure it will enter the alternating side of the rotary converters, issuing from the commutator side as direct railway current at 500 volts. The spare transformers mentioned above will be put into service when the headway of the trains is reduced. The static transformers are of the air-blast type, the windings being cooled by air forced through them by a blower. The rotary converters will be similar in construction to those used at Niagara, Buffalo and Nashua.

The use of the sub-station method of electrical distribution insures a uniform pressure throughout the entire length of the line. Fluctuation, therefore, which would materially interfere with the lighting of the station and trains, is reduced to a minimum. The limit of variation fixed by the Board of Trade, to the rules of which department all electrical installations in Great Britain must accord, is 10 volts. With the method adopted in this installation, the variation in pressure will not exceed three volts.

The locomotives will number 35. Each will consist of a sheet-iron cab containing the controller, indicating instruments, air-brake, pump and controller, sand boxes, etc., mounted upon a locomotive truck. The motors have been especially designed for this work. They are of the gearless type, and, according to the new system of motor nomenclature adopted by the General Electric company, are known as the G E 56. Four of these motors will be mounted on each locomotive, one to each axle, the total draw-bar pull being 14,000 pounds. The controllers will be of the series parallel type arranged for four motors. Each controller will embody the magnetic blow-out principle.



CENTRAL LONDON UNDERGROUND ELECTRIC RAILWAY.

The weight of each locomotive complete will be 35 tons of 2,240 pounds. The trains will be made up of seven cars, weighing, when loaded, 105 tons additional, giving a total train weight of 140 long tons. The seating capacity is calculated at 336 persons. Access to and exit from the stations will be effected by means of powerful high-speed elevators. These will also be of American manufacture, and will be built by the Sprague Electric Elevator company of New York. The elevators will be 49 in number, each with a capacity of about 15,000 pounds, or 100 passengers per trip. The speed of elevation will be about 150 feet per minute. These elevators will be of the double-drum type, similar to those built for the War Department at Washington, but of much greater carrying capacity.

It is estimated that the number of passengers which this road will carry per annum is 48,000,000, which, at an average fare of four cents, will give an ample return to insure dividends upon the capital stock.

Chicago City Railway Company Exposes Bribe Solicitor.

A six months' sentence for contempt of court in soliciting a bribe from a litigant was inflicted by Judge Brentano upon D. Knight Carter, a one-time prominent citizen of Chicago, who was serving as a juror on the trial of the $30,000 damage suit of Thomas Leach against the Chicago City Railway company on June 24th. When exposure came Carter sought mercy in a plea of destitution. A sensation was produced during the trial when ex-Judge Samuel S. Page of counsel for the street railroad company took the stand against Carter. Mr. Page told Judge Brentano in open court that Carter met him at the entrance of the Rookery building; that he spoke of the Leach case then on trial, but drawing to a conclusion; that he offered to secure a verdict in favor of Mr. Page's client if such a verdict was desired, and wound up by saying that "the railroad company knew where to find him if it needed his services." The accused admitted his guilt and was immediately sentenced to six months' imprisonment.

Mary Mesarosh, a Hungarian girl living at Hudson, N. Y., 17 years old, has been made demented by the searchlight of a steamer. The powerful rays were thrown into her room, and they frightened her so that she became insane. She was adjudged a lunatic and was sent to the Hudson River State Hospital, at Poughkeepsie, for treatment.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

HIGH WATER MARK

CIRCULATION, 20,000.

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WITH the Niagara Falls convention number of the WESTERN ELECTRICIAN, dated June 12, 1897, this journal made a new record for itself both in circulation and advertising. Of this 100-page number 20,000 copies were printed and circulated and the amount of full paid advertising matter carried was 8,643 square inches.

The remarkable success of this journal, especially in view of the hard times that have prevailed throughout the country, is all the more striking because of the fact that it is only 10 years since the first number was issued. Its advancement has been rapid and in keeping with the progress of the great industry it represents and the splendid field which it occupies. It is a noteworthy fact, especially in view of existing conditions, that during the period of depression this journal has made steady gains in advertising. Beginning with the convention number of March 3, 1894, the record shows constant gains each year until in the present case the number of square inches of full paid advertising matter is more than double that of the 1894 number. The figures showing this unprecedented gain are given in the accompanying table:

Issue.	Number of Advertising Pages.	Whole Number of Pages.	Square Inches of Paid Advertising Matter.
March 3, 1894....	40	56	4,145
February 23, 1895.	52	68	5,593
May 9, 1896.....	72	88	7,576
June 12, 1897.....	80	100	8,643

This constantly increasing patronage speaks eloquently of the influence and merit of this journal and of the confidence and respect which it commands throughout the country. It is pleasing recognition of the efforts that have been made in the interest of the entire fraternity.

THE Supreme Court of Minnesota says that when a "motoneer" discovers a vehicle on the track a short distance ahead of him, it is his duty to have the power which propels the car under his control, and to use it so as to avoid a collision with such vehicle if he can. The fact that the vehicle can be turned in either direction, and that the way is open for it to be turned, does not relieve the "motoneer," further declares the court, of the duty to use ordinary care to avoid a collision. If nothing more, this decision gives judicial approval to this title for the street railway employes to whom it is applied.

THE account given on another page of the interesting equipment of the Central London railway cannot be otherwise than gratifying to American pride. The entire electrical equipment and power-house engines are of American manufacture. It cannot be doubted that the promoters of the road selected American apparatus because they considered that, for their purpose, there was none other so good. Of course this is the truth; it might be said, indeed, that there is no other well developed and carefully worked out type, so great has been the expansion of electric traction in the United States. In a case like that of the new underground road in London, where the employment of the electrical system on conditions approximating steam railway service was imperative, it was necessary to have recourse to American engineers and American manufacturers. The English electrical houses make excellent apparatus, but they move slowly and were not prepared for this new demand. Hence, it was necessary to appeal to American experience.

By the way, was it not the London *Electrician* which, not later than the 1st of last January, demanded that "not a single American pole, not a pound of American plant, should be their [the English manufacturers'] motto"?

AN important decision was handed down on June 22d by the Supreme Court of Illinois in the proceedings instituted by former Attorney-general Moloney to prohibit the General Electric Railway company of Chicago from building and operating street railway lines under the franchise granted by the Chicago City Council. The court finds that the action was inspired by the Chicago City Railway company and the Western Indiana Railroad company, whose business was threatened by the new corporation, and it takes to task the attorney-general for becoming the willing tool of these corporations. The record shows that the Chicago City Railway company procured revocations, purchased or otherwise, from property owners living along the proposed routes of the General Electric Railway company, who had signed the petition to the City Council for the new company. Another feature of the case alluded to in the opinion is the fact that the attorney-general was silent under charges that he was paid for his professional services by the railway company. The attorney-general had based his action on the allegation that the General Electric Railway company had purchased consents from property owners, and that the petitions contained numerous forgeries as well as names of persons who were not qualified to give consents, but the Supreme Court refused to consider this feature of the case because the action had been inspired by a corporation which had resorted to similar methods in attempting to defeat the General company. The decision hinged on the requirement that the complainant alleging fraud must come into court with clean hands.

WHILE the Fram, with Dr. Nansen and his adventurous companions, was battling with the polar seas, the WESTERN ELECTRICIAN gave a brief account, taken from a magazine article, of the apparatus devised to produce light during the long arctic night. It now appears, from Dr. Nansen's book, "Farthest North," recently published in this country by Harper & Brothers, that the idea of operating dynamo by man-power was not realized. The explorer says:

It may be mentioned as an improvement on former expeditions that the Fram was furnished with an electric light installation. Baron Oscar Dickson provided at his own cost the electric installation (dynamo, accumulator and conductors), the dynamo to be driven by the engine, while under steam, while the intention was to drive it partly by means of the wind, partly by hand power, during our sojourn on the ice. For this purpose we took a windmill with us, and also a "horse-mill" to be worked by ourselves. I had anticipated that this latter might have been useful in giving us exercise in the long polar nights. We found, however, that there were plenty of other things to do and we never used it; on the other hand the windmill proved extremely serviceable.

Dr. Nansen mentions the use of kerosene in firing the boilers, but states that this method was soon abandoned, as the boilers were not adapted to it. He states that Dr. Neumeyer of Hamburg took charge of the magnetic equipment of the Fram.

THE most startling features of the Tesla discoveries that have been heralded by the daily newspapers throughout the country lately are those which are supplied by the imagination of the reporter or suggested to the reader in glaring headlines. There is nothing in what Tesla himself has said that could by any stretch of meaning be considered as justification for the conclusions which his enthusiastic newspaper friends predict, and yet this great inventor is possessed of a hopeful temperament and that confidence which is born of knowledge. When the subject of telegraphing without wires was discussed by Tesla years ago, he expressed the same confidence in the ultimate success of his work that marks his utterances to-day. Nor has he added much more to his expressions upon the topic of vacuum lighting. It is not to be inferred from this reticence that no actual progress has been made. Tesla is an indefatigable worker and he has been engaged almost constantly upon these problems. He is certainly entitled to success, and it is the earnest wish of all who have followed his career that he may be amply rewarded. But it must be admitted that thus far little information and absolutely no results of a practical nature have been given the world as the fruit of his years of toil in these particular branches. Still, Tesla is confident of success, and the world can well afford to share his hopefulness.

IT is about time for the street railway companies of Chicago to consider the problem of substituting a modern system for the antiquated and unsatisfactory cable, that mechanical monstrosity that is at present employed upon several of the most important trunk lines of the city. Since the introduction of the overhead trolley the people of Chicago have come to realize the imperfections of the cable service, and there are complaints on all sides because of the shortcomings and failures of cable lines to accommodate the public. It is evident that the Chicago City Railway company appreciates the fact that it will be compelled to substitute electricity in place of the present cable service, for it has bonded the new rails which it laid on State street and Wabash avenue across Jackson street, which is now being boulevarded. This action on the part of the South Side company indicates that it recognizes the growing demand for a change, and it is preparing to meet it. The only question that remains to be settled is whether an overhead trolley or a conduit system will be used. The street railway companies, for obvious reasons, would undoubtedly prefer to put in an overhead system, and it is believed that the people would welcome the change, but the opposition of the daily press might prevent the City Council from granting the necessary permission. At any rate it could cause serious delay. The people, however, have gotten over their dread of the overhead trolley wires, as practical experience has shown that with first-class construction there is really no danger from this source.

TELEPHONE MEN.

Independent Association Formed at Detroit—Activity in Other Directions.

Permanent organization of the Independent Telephone Association of the United States was effected at Detroit on June 22d and 23d, when representatives from all parts of the country gathered for the purpose of discussing the situation from the viewpoint of the operator of the independent exchange. The delegates were welcomed by Mayor Maybury and Mr. Flowers of the Detroit Telephone company, and a response was made by Judge Thomas of Chillicothe, Ohio. Judge Taylor of Fort Wayne followed with a brief address upon the Berliner patent and its effect upon the telephone industry.

The constitution of the new organization provides for the protection of operators and subscribers of independent exchanges and the establishment of a system of intercommunication between cities and villages with a reasonable charge for such service. Membership is limited to those actually engaged in the operation of independent exchanges. Provision is made for the selection of officers and committees, and their powers and duties are distinctly stated. A salary of $2,500 a year was voted for the president, $1,000 a year for the secretary and $750 a year for the treasurer. The actual expenses of these offices will also be paid by the association. There was considerable opposition to this feature of the constitution, as well as to the plan of assessment. Many members deemed the salaries too large and the rate of assessment exorbitant. Mr. Holmes, representing the Detroit Telephone company, said there were many objections among his associates to the constitution as it stood as a whole. They objected to joining a body organized for litigation. They believed in a commercial association co-operating to extend toll lines and to secure legislation favoring their purposes. The independent companies were popular and could get the legislation needed. What was really wanted was legislation, not litigation. Mr. Holmes objected strongly also to the charges per instrument and per toll-mile and to the heavy salaries. The proposed constitution was on the wrong path. It was foolish and suicidal. They should not give out, moreover, that they feared or expected litigation. If sued, they could attend to that when it came. The Grand Rapids exchange had met the agents of the Bell company three times on litigation and had downed them. Others spoke in the same strain, but the tendency of the majority was clearly in support of the plan of the organizers of the association. The officers elected were:

President—J. M. Thomas.
First vice-president—H. C. Young.
Second vice-president—E. K. Himes.
Third vice-president—T. Fricker.
Secretary—W. J. Vesey.
First assistant secretary—Z. W. Beers.
Second assistant secretary—D. C. Dow.
Treasurer—L. A. Carr.

President Keelyn on the Telephone Situation.

On Monday, following the recent Detroit gathering of telephone men of the United States, a representative of the WESTERN ELECTRICIAN called upon President J. E. Keelyn of the Western Telephone Construction company, at its Chicago office, to obtain his views on the results accomplished at Detroit. Mr. Keelyn said: "The Detroit convention, upon the whole, was as successful as a convention could be, held under adverse influences. To begin with, the association has for its object most laudable things. Its membership includes people from every section of the United States. Their ideas naturally differed widely in matters of detail, although they were a unit upon the main question. There were, of course, people who had axes to grind, who created a good deal of an uproar; but, like the bark of a stray dog, there was little but the noise to fear. Some of the reports which went out upon the convention will have an unpleasant effect temporarily. However, it will take only a short time to clear the atmosphere, and show the real character of the institution to be of a successful nature.

"Considering the magnitude of the undertaking, the diverse views of those congregated upon questions of detail, the convention accomplished an immense amount of work, and finally resulted in an organization which will very soon be operating effectively on clearly defined lines. In fact, it may be said that already the association is actively and systematically at work in line with the purposes of the organization. It will probably assume the usual attitude of successful institutions of its kind. Its work will be quiet and to the point in each instance. Before leaving Detroit almost every element of discord had been done away with, and it would astonish even those present to find how greatly changed some delegations are, and in the proper direction. The association can do a stupendous amount of good work, if properly guided. The officers and advisory board, having direct charge of its affairs, are men of unquestioned standing and the highest grade of intelligence. Every man is an earnest worker and a quiet fighter. As a matter of fact nearly every delegate showed that he was a fighter. If he had not been he would hardly have been in the telephone business. In conclusion, I believe that the public at large is to be congratulated that such a representative body of citizens from all parts of the United States has been found willing to espouse the popular cause of protection against monopoly and development of the great art of telephony, with so little actual financial gain to anyone, compared with the small pecuniary compensation for services."

H. C. Dodge Reviews the Convention.

General Manager H. C. Dodge of the American Electric Telephone company was seen on Monday last, and his opinion requested as to the convention. Mr. Dodge said: "About one-fifth of the independent telephone exchange companies of the country were directly represented at the Detroit convention. However, a large number were represented by the respective manufacturing companies with which they are dealing and to which they are looking for protection and assistance, in a large measure, in all that pertains to safe and profitable development of their business.

"We ourselves were in receipt of letters from not less than forty large exchange companies, asking us to represent them and use our best judgment in protecting their interests. It is a well-known fact that the independent movement has been so largely successful up to the present time because of the untiring efforts of a few old and experienced telephone men who have had the courage of their convictions and have possessed ability to construct apparatus of such efficiency that its users could successfully compete with service rendered by the American Bell company; and one of the most encouraging things incident to the meeting was the manifest spirit of harmony prevailing between operators of exchanges and legitimate manufacturers of apparatus. The expression of opinion that these interests are entirely mutual was gratifying. The prevalance of such confidence will tend as much as any other one thing to intrench the interests of all concerned.

"As to the apparent results which will follow the Detroit meeting, they can be conducive only to the welfare of all interested in the defeat of the Bell monopoly. While there were some differences of opinion and some dispute regarding matters of equitable taxation and representation, the very fact that these matters were brought up so concisely and ably, that all could appreciate the existence of the exact relation of the large interests to the small ones, will be the means of bringing about a speedy adjustment of disputed matters upon a basis satisfactory and equitable to all.

"In our opinion all of the opposition companies will eventually join the association, and harmony will prevail.

"The various interests were represented by successful, influential and conservative business men, of whose ability, sincerity and trustworthiness there existed no doubt."

Telephone Manufacturers Organize.

The manufacturers of independent telephones assembled at Detroit June 23d, and held an enthusiastic and harmonious meeting, and organized an association to protect and promote the interests of the manufacturers and users of independent telephones. The following named officers were elected unanimously:

President—H. A. Taylor, Standard Telephone & Electric company, Madison, Wis.
Vice-president—S. B. Rawson, Rawson Electric company, Elyria, Ohio.
Secretary and treasurer—J. Harry Lee, Viaduct Manufacturing company, Baltimore, Md.

An executive committee was formed, consisting of one member from each concern represented in the association. Ample means were pledged to carry out the objects of the association and conduct any litigation involving the independent telephone business of the country. The meeting was held behind closed doors, and no detailed report of the proceedings of the association will be made public.

Independent Telephone Association of Michigan.

Representatives of anti-Bell exchanges in Michigan organized a state association at Detroit on June 21st. J. B. Ware of Grand Rapids presided during the organization of the association, and Alexander I. McLeod of Detroit performed the duties of secretary. About fifty persons interested in the independent telephone exchanges of Michigan were present. Judge Hatch of Pontiac made an address, after which the convention selected the following-named officers for the permanent organization:

President—J. B. Ware, Grand Rapids.
Vice-presidents—W. L. Holmes, Detroit; James E. Davidson, Bay City; George W. Finch, Escanaba.
Secretary—Alexander I. McLeod, Detroit.
Treasurer—J. H. Fildew, St. Johns.
Executive council—Dr. J. Williams, Adrian; S. J. Higgins, Saginaw; F. B. Johnson, Lansing; Hugh O'Connor, Plymouth; Hugh Park, Muskegon; George Weed, Lake Odessa, and the president, secretary and treasurer.

The committee on resolutions adopted a report censuring the Michigan Central, the Grand Trunk and the Flint & Pere Marquette railroad companies for entering into a contract to allow the use of Bell instruments only in their stations.

Complaint in the Suit Against the Bell Company for Patent Infringement.

[From the Boston correspondent of the WESTERN ELECTRICIAN.]

The American Bell Telephone company has until August 2d in which to file its answer to the bill of complaint brought by the Western Telephone Construction company of Chicago, alleging infringement of the Keelyn patent. The subpœna is returnable July 6th. The bill of complaint alleging infringement, prepared by Attorney S. S. Stout and signed by M. B. Kennedy for the Western Telephone Construction company, is on file in the United States Circuit Court in Boston, and is substantially as follows:

The Western Telephone Construction company, a corporation organized and doing business under the laws of the state of Illinois, at 250 South Clinton street, Chicago, brings this, a bill of complaint, against the American Bell Telephone company, a corporation organized and doing business under the laws of Massachusetts and having its office in Boston in said district.

And thereupon your orator complains and says:

That your orator is informed and believes that prior to January 5, 1897, James E. Keelyn was the original and first inventor of a new and useful improvement in telephone instruments fully described in the letters patent hereinafter mentioned, and that said improvements had not been known or used by others in this country and not patented, or described in any printed publication, in this or any foreign country before his invention or discovery thereof, and not in public use or on sale for more than two years prior to his application for letters patent therefor.

And your orator, on information and belief, further shows that said Keelyn, being, as aforesaid, the first inventor and discoverer of said improvement, did, on the 27th day of April, 1897, upon due application therefor, obtain letters patent for the United States for said invention, in due form of law, and numbered 581,350, whereby there was granted and secured to said Keelyn and his heirs, administrators or assigns, for the term of 17 years from and after the date of said letters patent, the full and exclusive right and liberty of making, constructing, using and vending to others to be used, the said invention and improvements as set forth in said letters patent.

And your orator shows that by an instrument in writing, bearing date the 28th day of April, 1897, the said James E. Keelyn duly assigned, transferred and set over unto your orator the said letters patent.

And your orator further shows unto your honors that by virtue of the premises it became and now is the sole and exclusive owner of said invention and letters patent, and of all the rights and privileges granted and secured, or intended to be granted and secured thereby. And that since your orator became the owner thereof it has invested and expended large sums of money and has been to great trouble in and about said invention, and for the purpose of introducing the same into use and making the same profitable to itself and useful to the public; and that said invention is and has been of great benefit and advantage to your orator and the public; and that the public have generally acknowledged and acquiesced in the aforesaid rights of your orator, and your orator believes that it will realize large gains and profits therefrom if infringement by defendants and their confederates shall be prevented.

Yet the said defendant, well knowing the premises and the rights secured to your orator aforesaid, but contriving to injure your orator and to deprive it of the benefits and advantages which might and otherwise would accrue unto it from said invention, after as well as prior to said assignment as aforesaid, and before the commencement of this suit, did, as your orator is informed and believes,

at the city of Boston and elsewhere in the United States, without the license or allowance, and against the will of your orator and in violation of his rights, and in the infringement of the aforesaid letters patent, unlawfully and wrongfully, and in defiance of the rights of your orator, use and sell telephone switchboards embodying and containing the invention described in and patented by said letters patent, and that they still continue so to do; and that they are threatening to continue the aforesaid unlawful acts to a large exteot, all in defiance of the rights acquired by and secured to your orator as aforesaid, and to its great and irreparable loss and injury, and by which it has been and still is being deprived of great gains and profits, which it might and otherwise would have obtained, but which have been received and enjoyed and are being received and enjoyed by the said defendant by and through its aforesaid unlawful acts and doings.

And your orator further shows unto your honors, on information and belief that said defendant has had notice of said infringement and of the rights of your orator in the premises, but has disregarded said notice, and refused to desist from said infringements, and still continues so to do.

And your orator further shows unto your honors, on information and belief, that said defendant has made and realized large profits and advantages from said infringements, but to what extent and how much exactly, your orator does not know, and prays a discovery thereof. And your orator says that the use of said invention by said defendant and its preparation for and avowed determination to continue the same, and its other aforesaid unlawful acts, in disregard and defiance of the rights of your orator have the effect to encourage and induce others to infringe said patent in disregard to your orator's rights.

And your orator prays that said defendant, the American Bell Telephone company, and its and each of its servants, agents, attorneys, employes, workmen and confederates, and each and every of them, may be perpetually restrained and enjoined by the order of an injunction of this honorable court, from directly or indirectly making, constructing, using, vending, delivering, working or putting into practice, operation or use, or in any wise counterfeiting or imitating the said invention or any part thereof; and that the said defendant may be decreed to pay the costs of this suit; and that your orator may have such further relief as to this honorable court shall seem meet and shall be agreeable to equity.

And forasmuch as your orator can have no adequate relief, except in this court, to the end, therefore, that the said defendant may, if it can, show why your orator should not have the relief hereby prayed, and may, but not upon corporal oath (the oath being expressly waived), according to its best and utmost knowledge, remembrance, information and belief, full, true, direct and perfect answer make to the premises, and may be compelled to account for and pay to your orator the profits by it acquired, and the damages suffered by your orator from the aforesaid unlawful acts; and that the court may assess said profits and damages to a sum not exceeding three times the amount thereof.

Accompanying the bill are the letters patent describing Mr. Keelyn's invention. The patent is entitled "Telephone Instrument," and the application for it was filed January 5, 1897.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

Ninety-five men employed in the construction of the long-distance telephone line were quartered at Marengo, Iowa, recently.

John C. Baglien secured a verdict against the La Crosse & Southeastern Telephone company at La Crosse, Wis., for $1,900 damages for the destruction of his store at Lovass by fire, alleged to have been started from defective insulation. Lightning struck the wire and was conveyed into the store over it. The case will probably be carried up.

Employes of the Mutual Telephone company of Des Moines, Iowa, struck and demanded a raise in their wages from $2 to $2 25 a day.

The new building of the Northwestern Telephone Exchange company, at Fifth street and Third avenue, south, in Minneapolis, has been occupied by the general offices of the company, but the operating department will not be moved until spring. The building is built to meet the wants of a modern telephone exchange, and Manager Christie affirms it is the finest of its kind in existence. The operating room is 50 by 100 feet, lighted by large windows on two streets, and also by skylights. The room will have waiting rooms for the operators, finely equipped, and there will be a bath and other toilet accessories in connection. The new switchboard is being made in Chicago, and will not be ready until late in the year.

The Home Telephone company of Cedar Rapids, Iowa, which started last fall with about 300 instruments in use, now has about 600, and has toll connection with over 70 towns.

The annual meeting of the Erie Telephone company, controlling the Northwestern Telephone Exchange company, held in Minneapolis, resulted in the re-election of the old directors and officers.

The Rocky Mountain Bell Telephone company is preparing to make extensive improvements on its Coeur d'Alene system this summer. New poles and new wire will be put in at a cost of $10,000.

The Plymouth Telephone company of Plymouth, Wis., will put in a new switchboard and make other improvements.

The Council of Eau Claire, Wis., is considering granting a telephone franchise to the Western Telephone Construction company.

Nearly enough subscribers have been secured at Rapid City, S. D., to assure the Harrison Telephone company extending its system to that place.

The Cedar Valley Telephone company contemplates establishing a telephone exchange in Traer, Iowa.

The Northwestern Telephone company will extend its lines from Greene, Iowa, to Mason City.

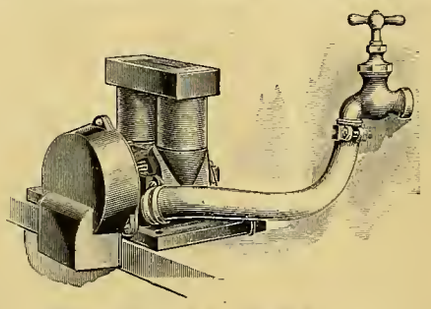
The American Telegraph & Telephone company is an applicant for a telephone franchise at La Crosse, Wis.

The Des Moines, Iowa, Council has ordered the Iowa Telephone company to put its wires underground. The cost is estimated at $30,000.

Business men of Hutchinson, Minn., contemplate putting in a telephone exchange.

Driving a Dynamo from a Household Faucet.

The Carlisle & Finch company of Cincinnati has recently placed on the market a small water motor and dynamo directly connected and combined to be used for general experimental work and for charging storage batteries, etc. The amount of water used is so small that there is ordinarily no charge for it, thus rendering it possible to obtain electric current at a trifling expense.



DRIVING A DYNAMO FROM A HOUSEHOLD FAUCET.

This is a most convenient method of charging storage batteries for bicycle electric lights, many thousand of which are now in use. Physicians also find this little machine well adapted to charging storage batteries for cautery and other medical work.

The outfit, shown in the cut, may be attached to any hydrant or faucet by means of rubber hose. The waste water falls from the bottom of wheel case into the basin or sink and is carried off by the waste pipe. Higher water pressure is obtained on the lower floors of all buildings, and it is best to connect as near the entrance of pipe into building as possible. The bearings of the dynamo are accurately made of brass or babbitt metal; they will run a long time with only occasional oiling. The commutator consists of two segments of ample wearing surface. The brushes are tipped with a heavy block of German silver and will run with very little wear. When worn out they may be replaced at trifling cost. The dynamo generates eight to 10 volts and one to two amperes, according to the water pressure. The higher the pressure the greater the output. It will light a six or eight candle power 10 volt incandescent lamp, or several smaller ones, if connected in series.

The machines are furnished with series or shunt winding. With the latter type and with 40 pounds water pressure two storage cells in series may be charged. With 90 to 100 pounds three cells may be charged. Bicycle lamps are usually operated by two cells.

The company reports a very large sale of this novelty.

The commissioners for the management of the Arkansas state penitentiary of Little Rock have awarded the contract for the machinery and construction for the state electrical plant to the Brown Electric & Machine company of Little Rock. There will be two two-phase 50 kilowatt Westinghouse alternators belted to 12 by 12 inch Imperial engines. The construction work includes about six miles of pole line and the wiring of all the state institutions. P. T. Parker is the consulting engineer.

A Speculation Regarding the Cause of Röntgen Rays.

By ELIHU THOMSON.

Since so eminent a physicist as Prof. J. J. Thomson has in a recent paper put forward the hypothesis of the breaking down of what we have been accustomed to call the "elements" and has shown a reasonable basis for such a hypothesis, the writer deems it not improper to state that a similar view had quite independently arisen in his own mind, the origin and progress of which may, it is thought, be interesting to others working and thinking in the same field. No apologies are offered for indulgence in the speculations herein presented. They are not presented as scientific theories, demonstrable by appeal to facts, but may possibly aid in investigation, and they are, therefore, given for what they are worth.

For some years the writer has felt that some light might be shed upon the nature and relations of the so-called elements could we attain exceedingly high temperatures by any means. The elements may have been evolved in the order of their complexity in a manner similar in some respects to the species of plants and animals.

About four or five years ago an experiment was planned as one possibly capable of permitting temperatures far exceeding that of an electric arc, our present limit, to be obtained. A temperature of less than 4,500° C. above absolute zero is not high when it is remembered that there can be no upper limit assigned to possible temperatures. Our chemistry is now all confined, so to speak, within lower limits than 4,000° C. to 5,000° C., and even within these limits most known compounds are decomposed or dissociated. Can we not raise our plane of temperature and give birth to a new chemistry in which the present elements, though apparently stable hitherto, shall become dissociated into simpler forms? For that they are complex is to be inferred from the complex spectra which all, not excepting hydrogen itself, possess.

It was seen that the temperatures attainable by electric means were limited by the volatility and consequent expansion into vapor of the substances subjected to electric current, but that if the expansion could be prevented there might result the possibility of securing indefinitely high temperatures. To do this it was planned that a very strong and thick, but short, cylinder of tempered steel should have a small central opening through it so as to make it into a thick tube. This was to be lined with an insulating lining of some simple compound, as magnesia, for example, in a perfectly pure state. A core or wire of, say, metallic magnesium, was to pass through this, after which carefully insulated heads or caps were to be very solidly clamped to cover the ends of the cylinder and form the terminals for the passage of an electric discharge. This would pass from head to head through the central core wire of magnesium. This discharge was to be that of an enormous condenser charged by alternating currents furnished by a step-up transformer, and the amount of energy to be delivered in a fraction of a second was to be made very large. The operation would be nearly instantaneous, and should result in enormously high temperature of the material within the steel shell. There could be no expansion to lower the temperature. A spectroscopic examination was to be made of all the materials present before the experiment, and a similar examination after the experiment should declare the presence of any element not there before. Reasoning on the idea that many complex compounds arise from sudden heating and cooling of comparatively simple compounds, it was thought possible that if dissociation of elemental forms took place at the enormously high temperatures the cooling would probably give rise to small amounts of the denser elements, discoverable, perhaps, by the spectroscope. These denser elements were to be the "elemental tars" or "polymers" of simple ones subjected to experiment. The experiment was to be varied in many ways. This general proposition was described to several associates at the time it was thought out. Among these are several well-known workers, such as C. P. Steinmetz, E. W. Rice, Jr., Robert Shand and others. The plan was recognized as a basis for a possibly fruitful research. There was no opportunity to prepare for the work, and the idea was allowed to rest in the hope that the future would yield the coveted freedom to undertake it. After two or three years the discovery by Röntgen of the peculiar radiation from the Crookes tube led to the writer's giving considerable time to investigation of the actions occurring, and probably as a consequence of the prior thought in relation to elemental dissociation

the idea came that in the Crookes bombardment stream the conditions, upon collision with the platinum anode, must represent those of an exceedingly high temperature of the gas. With certain exciting apparatus of great power it was found that the bombardment was so energetic as to heat in a few seconds an anode plate one-sixteenth inch thick and an inch square to intense glowing heat. Considering the small mass of the molecules of gas projected from the cathode, the velocity of their movement was seen to be extremely great if they were to convey the energy delivered in so short a time to the platinum anode. The layer of gas immediately in front of the platinum must, it appeared, reach an extremely high temperature and represent in a measure the conditions sought for in the proposed experiment with the steel tube already described.

The question arose, Could it be that the increase of vacuum was after all due to the formation out of the gas of small amounts of denser materials, or even that the elementary gases were decomposed at the high temperatures only to re-form on cooling but with a small "tarry" residue, so to speak, polymers, perhaps, or denser, non-volatile elements? If this were so, then the gas should should eventually all disappear in the same way. It does disappear, but how? We have guessed, but may be mistaken. We need to know more of it.

Considering these matters, it occurred to the writer that a cause for the production of Röntgen rays might be found if the elements were dissociated into simple or more primordial matter. Taking the view, which has much to support it, that in the spectrum of ordinary heat and light we find all those rates of electric oscillation which characterize vibrating molecules or the atoms of elements composing them; that they set up waves in the ether because the ether is essentially electro-magnetic; that the great rigidity of the ether, so opposed to its apparent extreme mechanical mobility, is after all only a chemical or electro-magnetic rigidity, bearing no proportion to its mechanical properties, any more than the ordinary fluidity of a chemical compound bears to the chemical stability of the compound—we arrive at an interesting supposition respecting the Röntgen ray emanation. If the residual elementary gases are broken up into simpler and finer matter within the area of the bombarded spot, the normal electro-magnetic rates of vibration of that finer matter should be far higher in pitch or of shorter wave lengths than in the case of the ordinary spectrum. According to this view, there would be no oscillation so slow as ordinary light originating in the finer matter dissociated from the elements at the exceedingly high temperatures represented by the colliding molecules or atoms immediately at the front of the platinum anode. All the wave lengths emitted as normal to the new forms of matter, only existent at the highest temperatures, would be of the Röntgen ray order, and a spectrum of such rays might characterize the matter present as the ordinary spectrum does the low temperature combinations. But absence of diffraction and refraction effects thus far are formidable obstacles to such analysis of these higher pitch rays.

The absence of the lower or Hertzian waves from sunlight probably depends on there existing no molecules or atomic aggregations in ordinary matter which can possibly vibrate electrically at such low rates. So in the hot primordial matter no ordinary light waves need be generated, but only the higher order known as Röntgen rays. The latter are the normal vibrations occurring in such matter. The spectroscope cannot help us in the analysis of these higher waves and the forms of matter giving rise to them. Further, if in the universe some of the hotter nebulæ contain this ultra-elemental matter the eye will not discover it, and the air around the earth is too absorptive for these higher rays to penetrate it and reach us. A "fire mist" of primordial matter must remain invisible until some part cools sufficiently to form aggregations which we call elements, which are, perhaps, only extremely stable forms, resembling in stability most of our known compounds at near absolute zero.

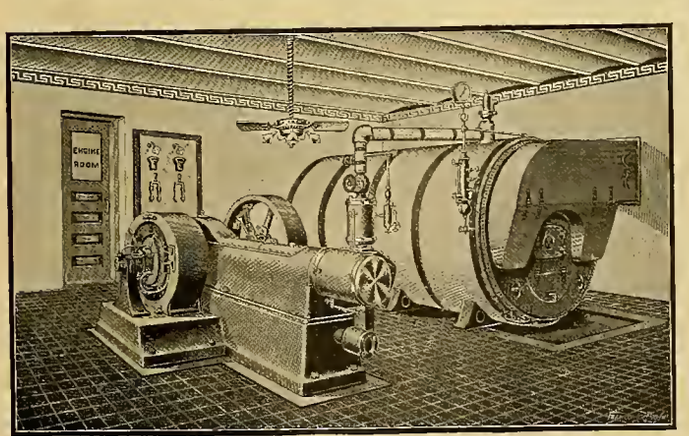
Admit the possibility of the view here expressed as a speculation merely, and it follows that there may be stars so hot interiorly as to possess only an outside layer of elements in the ordinary sense, while farther down within them are the black depths which shine only with the higher rays. Our sun has a low density, and if its interior, not subject to radiation loss, be of very much higher temperature than its exterior cloud of ordinary elements, a rift in the cloud might let out Röntgen rays which would produce electrical disturbances in the earth's outer atmosphere. Again, the mystery of the sun's supply of heat would be in part resolved. The heat given out in the formation of ordinary chemical compounds may be relatively very small compared with that yielded during the condensation of the ultra-elemental matter assumed into ordinary forms called elements under very powerful chemical or electrical forces. One can then conceive of a real photosphere surrounding the sun, and begin to understand the meaning of those tremendous outbursts of activity connected with prominences and spots. Ordinary elementary forms, arising by combination and cooling in the outer solar layers, would precipitate themselves into the hotter dark interior, to be violently decomposed, and this would occur over and over again, until the interior temperature was too low for it. Should the action become rhythmic we may begin to understand sun spot periods or stellar variability.

These ideas are not scientific in the limited sense; they are the result of imagination allowed free scope in dealing with imperfect data. The whole fabric must stand or give way according to fitness in the light of advancing knowledge of real facts. The history of science and invention shows that progess often depends upon a fortunate leap in the dark, and that no harm can come from consideration of many suggested hypotheses in a field where so little is known. To forewarn is to forearm, even if the final result is to expose a fallacy.

If the writer succeeds in drawing attention more than ever to such a fruitful field of research as the Crookes phenomena furnish, he will be satisfied. The conviction cannot be escaped that we have in them the opening of a new era in physical science—an extension of limits, a new chemistry perhaps.

The "Unitary" Lighting System.

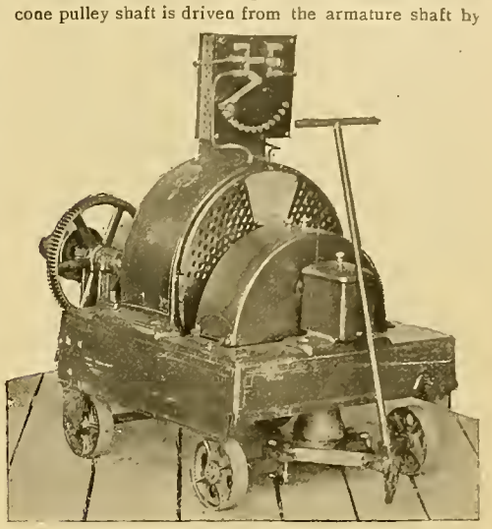
The J. B. Allfree Manufacturing company of Indianapolis, Ind., claims to be the first firm to put on the market a complete and comprehensive steam and electric plant as a unit, especially adapted to isolated or "block" lighting. This is termed the "Unitary power and light system." The picture gives an interior view of a power house, or basement room of a business block, with an Allfree safety boiler and a direct-connected automatic engine. The boiler is of the internal furnace type, having a large furnace flue extending from head to head, and provided with rocking grate bars. A combustion chamber at the rear conducts the gases into the tubes, which return them to the smoke head at the front end of the boiler, and then into the stack. No brick setting is needed, and only such foundation as is required to support the weight of the boiler. This type of boiler is claimed to be the most economical in use. As all the fire is contained within the boiler all losses of heat by radiation are avoided, being absorbed by the water contained within the shell. When properly insulated, or covered by a good boiler covering, the loss by radiation from the shell is inappreciable. The shell may be made of much heavier steel than is usual, and no cold air is admitted to the combustion chamber. This boiler is said to be comparatively inexpensive, cleanly, and one easily cared for. The engine is an Allfree center crank automatic engine, with extended shaft and base, on which is located a multipolar dynamo of any desired make, composing a compact, neat and handsome outfit. Automatic lubrication is provided for all working parts, which are provided with removable cast covers to prevent splashing of oil and exclude dust. The steam plants are made in sizes ranging from 15 to 150 horse power, or 10 to 90 kilowatts generator capacity.



"UNITARY" LIGHTING SYSTEM.

Card Portable Motor.

In large machine shops, structural iron works and other places where drilling or light boring has to be done on heavy material much time can be saved by the use of a motor if the latter is suitably mounted for easy transfer from place to place. The frequent calls for such a tool has caused the Card Electric company of Mansfield, Ohio, to bring out the mounted motor illustrated by the accompanying cut. All the working parts of the motor are enclosed as a protection against accidents from dirt or from the careless handling of material about it. The cone pulley shaft is driven from the armature shaft by gearing, and the ratio of the gears is such that the cone pulley is made to run as near 200 revolutions per minute as possible. On the armature shaft is a small pulley which can be used for driving high-speed machinery direct. The starting rheostat is non-combustible and has a double-pole switch mounted on it, and as all the connections to the motor are made before shipment from the factory nothing has to be done to put the motor in operation but connect the line wires to it. These mounted motors are manufactured by the Card company in sizes from two to 12 horse power, inclusive, and purchasers are furnished a list of gears from which they can select a pair to give the cone pulley a speed suitable for their requirements.



CARD PORTABLE MOTOR.

Test of an Electric Railway with Underground Current Supply in Hamburg.

The *Hamburgischer Correspondent* of April 4, 1897, gives a favorable account of the trials made last winter on the Lachmann system of electric railways with buried conductors. The testing track is only 525 feet long, but it is of normal gauge and arranged with varying grades and curves, and part of it is depressed so that it may be overflowed. The car had a capacity of carrying 36 passengers and was operated by current supplied at 500 volts. The tests were made during rainy, unpleasant weather and are said to have been very severe, part of the track being submerged. The system makes use of a shallow conduit or trough with a slotted opening about three-fifths of an inch wide. One trial consisted in running the car into the water on the submerged portion, allowing it to stand there and then starting up. This is said to have been successfully accomplished, and the writer of the article in the *Correspondent* says: "It is therefore proven by repeated trials that the entrance of water into the conduit of the Lachmann underground system does not cause any important disarrangement in the operation of the railway." It is calculated that the road (single track) would cost about 40 marks per meter to build, or about $17,000 per mile. The Council of the city of Vienna, it is said, has voted a credit for a trial track in that city to be at least 2,000 feet long.

The Commonwealth electric ordinance has passed the Common Council of Chicago, over the mayor's veto.

Municipal Lighting.[1]

By W. Worth Bean.

The subject to which I would respectfully invite your attention is one of the most vital questions, and of the most momentous importance—not only to the profession to which we have the honor to belong, but also to various commonwealths of which it is our pride to be citizens—that has ever arisen in this advanced electrical era. Municipal ownership of electric lighting plants, the most discussed of all the questions of municipal polity, is the more insidious that it comes dressed in the sheep's woolly garb of a philanthropist, which to the uninitiated and ignorant has an alluring and plausible aspect, but to the experienced are plainly visible the wolf's deadly fangs, which have in every instance, sooner or later, lacerated the taxpayer. The authors and promoters of this alluring scheme are either visionary theorists, who have no practical knowledge of its manipulation, or unscrupulous politicians who, desiring to pose as benefactors to the municipality, hope to ingratiate themselves in the hearts of the voter and thus secure political plums for themselves and their henchmen. That there are many honest supporters of this political fad who, having been deceived by beautiful but false reports from cities which are experimenting with this question, are misled by political demagogues, is undeniable.

The tidal wave is sweeping over our land, and certain municipalities are now on the crest, but it will not need the average period of depreciation in a plant for the wave to subside and leave the wrecks stranded with increased burdens and depleted treasuries. Already cities have sold their plants, paying dearly for their experience, and others are looking for buyers, in order to unload their "white elephants." Municipal ownership is contrary to the spirit of republican institutions.

From the Declaration of Independence we read: "We hold these truths to be self-evident, that all men are created equal; that they are endowed by their Creator with certain unalienable rights; that among these are life, liberty and the pursuit of happiness; that to secure these rights governments are instituted among men." These are the fundamental principles of our republican form of government, and nothing therein can be construed to mean that government was instituted for the purpose of becoming a commercial producer. The framers of our constitution had no idea that the government they were establishing would ever enter the field of competition to the discouragement of private enterprise. The political demagogue of the present day would read the above extract about as follows: That all men are created equal—except central station men; they are endowed with certain unalienable rights—except central station men; that among these are life, liberty and the pursuit of happiness—except furnishing municipalities with electric lights; that to secure these rights—and also municipal ownership—government was instituted among men. No! Government, whether national, state or municipal, was instituted for the purpose of protection and not production. It would be just as reasonable for the city to enter any pursuit, such as farming, or as a grocer, or keep a sawmill to saw its own material for sidewalks or paving, or manufacture shoes for its citizens, or run a saloon for the profit there is in it, as for it to enter the field of lighting. Just as sure as a nation becomes a commercial producer, competing against its own citizens, just so sure will the seeds of its own disintegration be sown.

Municipal ownership is a source of danger to the commonwealth, in that it affords a great opportunity for fraud. Municipal corruption is so common and so well known that it needs no argument to prove the danger of opening a new avenue of power in the hands of unprincipled public officials. In this business there are a number of important, and ought to be well salaried, offices, which can be used to great advantage by political manipulators to further their own ends to the detriment of the city. In the state of Michigan one political party had been in power for 34 years until 1891. A member of the old party was elected to the Senate and introduced a bill to benefit Coldwater, Mich., and this has been the Mecca of the municipal advocates ever since. It has been the oasis in the desert where the could get sweet morsels to roll under their tongues to advocate the scheme of municipal ownership. I venture to say that more than a score of towns and cities have charged up expenses for the examination of this delectable plant, and from their own printed statements I am willing to qualify that the figures are not as they should be made. Reports come from Grand Haven, Mich., that through political influence a competent electrical corps has been discharged to make room for inexperienced friends of the "powers that be." "To the victor belong the spoils" is a policy followed with unswerving fidelity by a great many city officials. Scandals from our great cities in regard to employes, inspectors, officials and boodle alderman should teach us to avoid throwing this enterprise, involving hundreds of thousands of dollars, and positions of the utmost importance to the city, into the maelstrom of municipal politics.

Municipal ownership is unjust to the electrical plant now in the field. The central station man has, through his industry, ingenuity and executive ability, built up a large enterprise. The city has invited him to invest thousands of dollars, not only of his own money, but also the money of its own citizens, with no immediate show of dividends, and, in some cases, barely sufficient income to pay the running expenses and interest on the bonds during a period that will amount from one-half to the whole of the average amount of time allowed for depreciation of the plant. The central station man during this time has been harrassed with the anxiety of meeting the fixed charges, maintaining the credit, providing a reserve fund to meet loss by fire, windstorms and burned-up apparatus, and cheering up despondent stockholders who have nothing to show for their money but the rosy-hued prospect that, at some time in the near future, there will be an adequate dividend to compensate them for their risk, and now, when these hopes are about to be realized, in a modest degree, they are confronted by municipal ownership. He must either compete with the city—which, through ignorance, will furnish lights below cost—or sell out. The latter proposition is impossible, for he cannot hope to dispose of a plant that has depreciated 50 or 75 per cent. without great loss; therefore he is compelled to continue in business with his former heaviest consumer now his strongest competitor, with the prospect of having to renew his plant within a very short time, at a heavy expense, and knowing full well that there is room for but one paying plant in a city of that size. Such conduct on the part of the city amounts to the indirect confiscation of property; obtaining a competent and effective service for years without profit, holding out the alluring representations of a future gain.

Municipal ownership is unjust to the taxpayer. That through ignorance or willful errors in keeping accounts it is certainly true, in most cases, that lights are furnished to the city and private patrons at a loss, and the deficits charged to some other accounts. Very few of its citizens are able to take the lights at the reduced price, for the great majority of its citizens are day laborers, who are paying for their homes, and cannot afford to take the lights even at any price, but who eventually must help to carry the burden of the ever-increasing loss, thus making the many help pay for the luxuries of the few. The city clerk of Hamilton, Ohio, utters a dismal wail, recorded in the *Electrical Engineer*. He says:

> Hamilton, of all the cities in the United States, is the most afflicted with the municipal ownership craze, and, having had its fill on theory, is now reaching the result under adverse circumstances. We are deluded in the belief that we have cheap water, cheap gas and electric lights, but when we add to these luxuries the fact that we have so raised the rate of municipal taxation until it has become burdensome, and then compare with other cities of our size, we are not so well off as we think we are. We are taxed to pay the interest on the gasworks and the electric light plant, as well as to provide for the redemption of the bonds, and we are also taxed for the purpose of lighting the corporation, which is nothing more than a double taxation.

Municipal ownership has cost the city $575,000. It is reported that an order has been made to discontinue the electric lights, on account of lack of funds. This has been a very expensive experience for Hamilton, and the taxpayer who has burned nothing but an oil lamp now helps to pay the bill.

The result, in most cases, will be less efficient service than under the competitive system. Central station men who have been in the business for a long time, and who have had years of experience, are, without doubt, the most competent to give the best service of the times. He surrounds himself with expert electricians and a corps of able assistants who have been educated in the business and retain their position by the strictest attention to duty. He is continually devising means for improving his service, not only in employes, but also in the latest improved machinery. On the other hand, municipalities change their officials frequently and new men take control. Councilmen who oftentimes are not even good business men, and have no knowledge of apparatus and electrical affairs, pass on the purchasing of supplies and the competency of electricians and engineers, deposing experienced incumbents and apportioning political plums to friends of but ordinary ability. The men now in control attempt to compete with electrical experts and competent engineers of long experience, and about the time when they are beginning to understand their plant and how to save loss—in a year, or possibly two—the council changes, and they must step down to make way for those of even less ability. Again, in smaller cities councilmen are often elected on the single issue of economy, and in order to fulfill the expectations of their constituents, they must cut expenses. The first attack is made on the official salaries, which results in filling responsible positions with inefficient men. Experts cannot afford to educate themselves for positions commanding low salaries and subject to the vicissitudes of municipal politics, and we all know too well the cheap men in this business are the most expensive. Then, again, the economical councilmen will object to improving the plant, which will require vast sums in replacing that which has but lately cost so much, and for which they have not as yet finished paying. This is especially so if the improvements are demanded in a time of financial depression, and when taxes are already too high. Electrical plants, of all apparatus, are the most liable to be out of date, as in this class of machinery improvements are sudden and extremely radical, and what to-day is the best that can be bought, to-morrow, next month, or next year, is nothing but scrap iron if placed on the market. City councils do not realize this, and in nine cases out of ten, would refuse to appropriate the necessary funds for the needed improvements, and, as a consequence, their antequated machinery, combined with inexperienced management, gives the city the meanest service for the highest price.

The glowing reports from cities that are experimenting with this question are unreliable and misleading, except to the electrical profession. In some cases, where the plant is new and there is no perceptible depreciation, and where they have providentially escaped accident or disaster, no doubt these statistics are honestly, though ignorantly, compiled, deceiving the taxpayers into the belief that their venture is a glorious success. The engineer's salary and the coal bill are often charged to the water department, and the water consumer helps pay the electric light bill.

In most instances the item of interest on the outstanding bonds is charged instead of interest on the entire plant, and four per cent. depreciation is charged, whereas from 10 per cent. to 15 per cent. should be the rate. In some cases losses by fire are not accounted for; in others accidents are never charged. The loss to the city of the taxes that would be paid in by a private corporation is not computed, and in a great many cases the accounts are so mingled with other departments that it is impossible for even the officials themselves to tell how much the lights for street purposes cost the city. The chairman of the special committee of the municipal and opposition ownership, in his report to the Northwestern Electrical association, says:

> We have endeavored to investigate the results obtained in the municipal plants already established, but find that this cannot be properly done, except by sending a capable representative to these plants. We have written for regular city reports, and have sent out blanks requesting answers to a number of questions asked. We find that, in the majority of instances, the expense report, as covering the cost of electric lighting, does not cover such cost, as is evidenced by finding electric light expenses charged under separate heads, and in but few instances does the city figure anything against the plant for interest, depreciation, taxes, water rent, office rent, management, fire insurance, water insurance, employers' liability insurance and general risk. It is needless to say that, without including but a portion of the expense of conducting an electric light plant, they can send out reports that look very inviting to other cities that are paying a fair rate for lighting their streets and houses. The easiest way to demonstrate the fallacy of this scheme is by making a personal investigation and determining just what portion of the expenses are omitted that should be figured against the cost of the city's expenses in operating their electric light plant.

I have personally visited Niles, Kalamazoo and South Haven, Michigan, and I know that these cities are paying more for their lights than their official reports show what they cost, and yet they are considered among the list of those which are successful with municipal lighting. The city of Detroit has probably the finest equipped plant in the state of Michigan, and operated under the most advantageous circumstances, and yet she pays $100, in round numbers, per lamp, for 1,483 lamps under municipal ownership, while St. Joseph and Benton Harbor, under the relentless pressure of a private corporation, only pay $90, on an average, for 62 lamps. Tipton, Ohio, and Marquette, Mich., had serious accidents, and the deluded taxpayer, with his eyes partly open, refuses to vote more money for such a hazardous enterprise. It is not every city that can boast of the advantages which South Norwalk, Conn., enjoys, and of which she should well be proud, in that she has an expert electrician and a retired army officer to guard her plant from the evils that have blighted most enterprises, and, no doubt, to their efficient services is due the momentary success attributed to that municipal plant (I am informed, however, that their services are free to the city); but in the great majority of cases the city is not so favored, and the central station man, by his well earned knowledge and education in the profession, by his intimate acquaintance with the plant, and by the rigid economy that only comes from long experience, is enabled to furnish the city with the most efficient service, at the same price or even less than the same price that it actually costs the city to produce its own light, and yet save for himself a reasonable profit for his enterprise.

At this present writing, however, municipal lighting has not passed through its most dangerous period, and it is difficult to predict its final result. It is now but at the dawn of its existence, but a December day will be long in comparison with the life it has to run, for when bonds are to be redeemed, accidents befall the plant, and a depreciated plant is to be renewed; then comes the trying ordeal, and woe be to the city that has not provided against that day, but has wasted its substance in riotous living, for then it will be found to have nothing left for its existence but the husks of "municipal lighting."

It is to be hoped that each and every member of this association, and of every central station, will constitute himself into a committee of one to get reliable data concerning municipal ownership, and present it in a proper form to the thinking public of this country, and after a full and thorough examination by the voters and taxpayers in this broad land, I think the question will be effectually settled.

Thanking you for your attention, and hoping for your hearty co-operation in dealing with this all-important question, I respectfully submit this paper for your consideration.

Discussion.

H. L. Doherty: I consider this subject a very serious one. I am out of the woods myself, but I have had a little experience, as has Mr. Bean and several other members. The city plants now in operation are dismal failures, but every one of them sends out reports that look very inviting to other cities.

J. I. Beggs: The remarks of Mr. Doherty prompt a suggestion, taking a text from the president's remarks this morning, that he didn't think it was necessary for an association of this kind to have a large surplus fund. It seems to me that there is no use to which the association could devote a part of those funds with greater advantage to the central station and lighting interests of the country than to employ an intelligent, painstaking expert to get reliable data from a number of municipal plants in different sections of the country. As has been well stated in this paper, the data that is available, except in very few cases, is unreliable in the extreme. I believe that the only municipal plant that has put forth a report that is entitled to any respect as to its credibility is that of the city of Detroit; and certainly any central station manager here, I think,

1. Read before the National Electric Light association at Niagara Falls, N. Y., June 8, 1897.

would be very glad indeed, if he were running the central station in the city of Detroit, to furnish their lighting at as low rates as they are getting now, and relieve them of all the disasters that Brother Bean has suggested are likely to overtake them in the future in connection with their own investment. But, as I had occasion to say once before in this convention, I think the city of Detroit was entirely justified in doing what it did. It was driven to it. And, gentlemen, let us take a text from that ourselves. Do not compel the municipalities in which you are managing electric light plants to put in for their own protection the means of lighting themselves. I take two papers that have been presented here this afternoon and I contrast them; and I suggest that from my standpoint the one that was read just a little while ago would be better if some of the things said in that paper had not been said. I refer to it now simply to suggest that in the paper read by Mr. Cahoon earlier in the afternoon session the inference might be drawn that the balance of your business in many of these cities in which you are doing business is unprofitable, but it is made to show a profit because of your city contract; and I refer you to the first page of Mr. Cahoon's paper. I desire to draw attention to that fact here, because it is incumbent upon us who have large capital invested in different sections of this country, to feel that we are doing what we can do in a legitimate way to render unnecessary the exploitation of municipal plants by municipalities over the country; and therefore we should see how we can reduce the cost of producing electric current to a price where we can show to a city that we can supply current because of the large business that we are doing and because of having this expert knowledge, better knowledge of the conditions necessary to run a plant economically than they can possibly have. But, unfortunately, many plants over the country have not done that.

The accompanying data, relating to the depreciation of the city of Detroit's lighting plant, were compiled by the debaters of the Wisconsin University who so successfully upheld the negative side of the question, "Would it be advisable for the city of Madison to establish its own lighting plant?" It will be noted that they have entirely omitted depreciation or appreciation on the real estate exclusive of buildings. Of course, the depreciation or appreciation on this property is an unknown factor, but the balance of the data is extremely interesting, inasmuch as competent authorities were consulted in reference to the depreciation on the several divisions of the construction, and in each case the lowest figure given was accepted. A correspondent who furnishes this data says that if it is accepted by thinking people, it proves beyond a doubt that the city of Detroit is losing considerable money through the ownership of the electric lighting plant, to say nothing of the possible loss which may occur through unforeseen changes in the manner of producing light, or accidents which are not beyond the line of possibilities:

	Cost.	Rate of depreciation.	Amount of depreciation.
Buildings, sidewalks, docks, floors, railroad track, etc.....	$224,741.00	.025	$ 5,618.52
Lamps and electric machinery...	70,047.00	.10	7,017.00
Pole line.....	107,779.00	.20	21,555.80
Conduits.....	87,602.00	.075	6,570.15
Steam plant and machine shop..	87,530.00	.075	6,564.15
Total.....	$507,016.00	8.3%	$47,355.62

Government Ownership a Failure.

[From the *Allegheny Record*.

The action of Brazil in abandoning state ownership of railroads must attract attention of all students of socialism. The attempt of the Brazilian government to make the railroads profitable has not been successful financially, and it has recently offered to lease the entire system of 14,000 miles of track to any responsible company that would pay a bonus of $70,000,000, this bonus to cover the rental of the tracks, rolling stock and other property pertaining to the railways for a term of 50 years, and to be accompanied by guarantees to restore the property in good order at the end of that period. No further obligation is incurred, except the ordinary taxes. Two syndicates—one composed of German capitalists, in which Herr Krupp, the gun manufacturer, was prominent, and the other of English bankers who already have large interests in Brazil and other South American companies—presented informal proposals which, however, did not comply with the conditions, and were not considered by the authorities. Some of the Brazilian roads which used to pay dividends before the government took control began to run behind almost immediately upon the assumption of government ownership. Thus the Central railroad, which formerly paid a nine per cent. dividend, has been costing the government $2,000,000 or $3,000,000 more than it earned. This is true in measure of the other roads.

Copper, Platinum, Zinc and Mica.

The annual report of David T. Day, the chief of the government division of mineral resources, shows that the production of copper in the United States in 1896 far exceeded that of any previous year, being 453,007,139 pounds, valued at $48,698,267, nearly equal to that of the gold produced in the country, and largely exceeded in value only by iron and by silver when computed at the coining value of the latter metal. To the electrical industries of the United States and of other countries is to be attributed the increasing demand for copper.

Zinc does not show a like increase, being exceeded in quantity and value in several years previous to 1896. The figures for last year were 81,499 tons, valued at $6,519,920.

The report shows that platinum is one of the metallic products of the United States, although the amount is very small, varying (for the years from 1887 to 1896) from 75 ounces in 1893 to 600 ounces in 1890. The quantity produced in 1896 was 163 ounces, worth $944.

Among the non-metallic products enumerated mica is perhaps of most interest to the electrician. The quantity produced in 1896 is not given, but the value was $57,041. The table shows that there has been a falling off in the domestic production of this useful product, especially noticeable since 1893, although the year 1887 witnessed the greatest valuation of American-mined mica—$142,250.

Litigation over Walker Company's Plans.

Judge Taft of the United States Circuit Court at Cincinnati has granted the Walker company a restraining order, preventing W. H. Bone and R. T. Bone from delivering to supposed competitors certain plans, specifications, data and figures said to be exclusive by the property of the Walker company. The company declares in the bill of complaint that the defendants were employes of the Walker Manufacturing company, and after the organization of the Walker company they were continued in the employ of the new corporation. The plaintiff states that Messrs. Bone are the custodians of valuable papers, plans, etc., containing secrets of the business. These plans, it is averred, cost the Walker company in excess of $50,000, and are of immense value in the business. The company then goes on to say that the defendants, acting in connection with other parties whom the company believes to be competitors in business, but whose names it has not been able to ascertain, have been taking copies of plans, specifications, data, figures, and practically all of the valuable secret equipment and business of the Walker company. The bill of complaint further alleges as follows:

The defendants have been secretly carrying on their plans in connection with other employes, and with the knowledge of parties not in the employ of the plaintiff. They have continually been carrying away tracings and drawings used in the business, contemplating to deliver such. The defendants are contemplating quitting the employment of the plaintiff, and using or disposing of the plans, which information they have acquired only by means of their employment in the service of the plaintiff. This information is secret, valuable and confidential. The plaintiff believes and is informed that they have in the day and night time entered the works and carried away property, the full extent of which is not known. They have copied or duplicated these plans, returning the originals to their place.

Failure of a Horseless Carriage Competition in England.

The *Engineer* of London is not so enthusiastic over horseless carriages as it was. It offered a prize of 1,000 guineas for the best motorcar, as this type of vehicle is denominated by some of the English writers, but the committee in charge found no entry worthy the prize. No fewer than 72 entries were made. When it came to the point, however, five vehicles appeared, and the judges found none that they could conscientiously give a prize to. The result seems to show that there is no such thing as a motorcar industry in England, and "no such thing as a thoroughly satisfactory self-propelled vehicle there."

Of one type the judges make this comment: "The electric car is an ideal motor carriage; no dirt, no smell, no noise; steered by a pair of reins; its power adjusted by a slight motion of the seat beneath the driver. It was enough to see this vehicle running quietly about the grounds, up hill and down, without the smallest hesitation or trouble, to be convinced of its merits. In the details of its mechanism it is simplicity itself; but, alas! it has the fatal defect that it cannot store electricity enough for a run of more than about 20 miles. Yet even with this limitation it is difficult to believe that there is not a future for the electric motorcar."

It is to be assumed from this that the manufacture of electric carriages has not proceeded so far in Great Britain as in this country.

J. H. Torrey, Winnipeg, Manitoba, has secured the contract for the electric wiring and fixtures for the new Winnipeg Opera House.

General Electric Railway Franchises.

The Supreme Court of Illinois has confirmed the General Electric Railway company's franchises, and that corporation is now in position, so far as legal rights are concerned, to construct and operate an electric railway system upon the South Side in competition with the Chicago City Railway company. The litigation was started in the name of former Attorney-general Moloney, but it is claimed that is was inspired and conducted by the Chicago City Railway company and the Western Indiana Railroad company. The court in the opinion gives the following summary of facts as the result of its investigation:

Almost the whole of the street railway traffic of the South Side of the city of Chicago is at present conducted by the Chicago City Railway company. If the new road be opened up, as contemplated in the ordinance in question, it will compel the Chicago City Railway company to divide its passenger traffic with the new road. Thus the interests of the City Railway company are seriously imperiled. It is not to be wondered at, then, that this record discloses by numerous affidavits that the Chicago City Railway company has procured revocations, purchased or otherwise, from property owners living along the line of the proposed road. Nor is it to be wondered at that able and eminent counsel has appeared in this court to assist the attorney-general, who meets with silence the charge made in open court that he is being paid for his professional services by this company.

Without doubt the interests of both the Chicago City Railway company and the Chicago & Western Indiana Railroad company and its lessee roads, some of whom carry on a suburban passenger service, would be imperiled by the building of the General electric railway. During the long arguments before this court it was not made to appear to the court that any other property owner or citizen save and except those companies would suffer any injury from the building of this road. These considerations have been forced upon the court during the arguments, and that they are proper to be taken into account is shown by the language of other courts in passing upon like cases.

From the evidence in this record we cannot escape the conclusion that the inception of this information, its progress in the court below and what has been done here is in the interest of these rival companies. This information does not appear to have been filed to preserve a public right or benefit. It is, if sustained, preventive of a healthy compensation in the interest of the people resident in that part of the territory in Chicago where the road is proposed to be constructed. It is to the disadvantage of the corporations which the chancellor found were the only parties in interest aiding in this proceeding. The infraction of public rights, if any exist, is not that of which the people complain. The complaint made on this information is not for the public welfare.

The court accordingly sustains the decision of the lower courts and refuses to grant an order prohibiting the building and operation of the lines by the General Electric Railway company.

Electrical Oil Pumping.

[From the *Canadian Engineer*.]

An interesting and highly successful experiment has been carried out at Petrolia by W. H. Ashworth, manager and electrician of the electric light company of that town, in applying electricity to the pumping of oil. Out of the 8,000 oil wells, which yielded about 800,000 barrels in Canada last year, there are nearly 6,000 in and around Petrolia. One would think that in a town like Petrolia, where they have "oil to burn," so to speak, they would use some kind of crude oil engine, or at least use oil as fuel for the steam engines that are required on the fields. But they do neither. They use steam engines to work the pumps that lift the crude oil, and they use wood and coal for fuel for these engines. As those acquainted with the petroleum business know, the wells are bored in all directions about the town, many of them in the back yards of the owners' houses, so that the visitor on approaching the town sees a forest of derricks, looking like the stumps of trees left after a fire has passed through a green forest. Under each derrick is a well, worked either by a "walking beam" or a "kicker"—that is, two arms joined at right angles, one arm slanting vertically, the other horizontally, the latter having the pump rod attached to its outer end. A group or "batch" of these wells is operated from one engine, rods and scantlings being connected from the engines to the kickers and walking beams. The wells run by one engine are at all kinds of angles to each other, this being easily accomplished by a crude horizontal wheel, making a quarter turn and back, and so pushing and pulling the rods of the pumps on its line. By putting a wheel whenever a well has to be reached at an angle, a dozen or even 30 wells may be reached from a single engine. Mr. Ashworth last July undertook to operate a "batch" of wells from the dynamo in the Petrolia Electric Light company's power house, and installed a six kilowatt 500 volt Canadian General machine in a small building in the field beside one of the old engine houses. The little shed required for the purpose was only half the size of the steam power house, and no heavy foundation or boiler setting was required. The machine was placed on a frame consisting of two pieces of 10 by 10 inch timber on each side, one on top of the other, to give a clearance from the ground for the

driving gear, which was a set of pulleys belted so as to reduce the motion imparted from a main shaft operating a crank at either end, the two cranks being placed so as to give an alternate motion to the two sets of pump rods; this simple apparatus was attached to 16 very heavy wells known as "water wells," and running at much higher than the usual speed, but they have been run most successfully by electricity ever since. No boy or man is required for firing, and the machine requires no attention after it is started each day. Last year in Ohio or Pennsylvania one or two wells were experimentally operated by electricity, there being a separate dynamo for each well, but this, we believe, is the first case on record when a "batch" of wells has been electrically operated.

Proceedings Against the Electrical Journal Publishing Company.

On Monday, June 28th, the attorneys for A. W. Stevenson filed an amendment to the latter's bill asking for the appointment of a receiver for the Electrical Journal Publishing company. No receiver has been appointed, although by a curious mistake on the part of a court clerk the WESTERN ELECTRICIAN was led into the error of so stating last week, this being the result of an entry on the clerk's docket stating that an order to that effect had been entered by the court, when in fact such order had been reserved for further consideration. The amended bill will probably come up for action on the next contested-motion calendar, and may be acted upon on July 6th.

CORRESPONDENCE.

New York Notes.

NEW YORK, June 26.—An interesting legal examination of Bell telephone men is in prospect. The Appellate Division of the Supreme Court decided yesterday that Simon Sterne is entitled to examine before trial the officers of the Metropolitan Telephone & Telegraph company and their books in his action to enjoin the company permanently from removing a telephone from his office for which he paid $150 a year and which the company proposes to replace with a better telephone at $240 a year. The court says that as the questions at issue are whether the company was not doing a profitable business at its former rates for telephones and whether the improvements in the service are of a character to require an advance to $240 a year, the examination of the defendants in connection with the company's books can be required by the plaintiff.

The litigation growing out of the endeavor of the Metropolitan Street Railway company to introduce electric traction in Eighth avenue and other streets drags on its weary way. The appeal from Justice Beach's decision, which was adverse to the city's right to buy the road, was argued before the Appellate Division of the Supreme Court on Tuesday. Several eminent lawyers spoke. Wheeler H Peckham, for the property-owners who began the action to prevent the construction of an electric system, argued that the city had a perfect right at any time to take possession of the road on paying the original cost of construction. He also touched upon the powers of the Board of Electrical Control, arguing that the company could not put electrical conductors under the surface of the street without the consent of that board. Assistant Corporation Counsel William L Turner spoke for the city. He said that the city had taken an appeal solely for the purpose of having the powers of the Board of Electrical Control in the matter judicially determined. The city authorities did not regard it as open to serious question that the Legislature had the power to authorize the change proposed. The corporation counsel also urged that the question of the city's right to purchase the road at any time should not be decided upon a taxpayer's petition, but should be reserved until such time as the city might undertake to exercise this right. These points being put aside, Mr. Turner argued that the court should restrain the construction of the electric conduits proposed until the company submitted itself to the Board of Electrical Subway Commissioners. As the summer vacation begins at the end of June the case may not be decided until fall.

M. S.

PERSONAL.

Prof. E. P. Roberts of Cleveland was in Chicago last week.

M. L. Livingston, assistant general manager of the Standard Thermometer & Electric company, Peabody, Mass., spent a few days in Chicago last week looking after the interests of his company.

J. Orne Ryder has resigned his position as secretary and treasurer of the Crown Woven Wire Brush company of Salem, Mass.

B. F. Small, secretary of the Electric Cigar Lighter & Advertising company, St. Louis, was in Chicago last week in the interests of his company.

H. Barrington Cox of London, England, spent several days in Chicago last week with S. F. B. Morse. Mr. Cox, during his visit in this country, renewed acquaintance with many friends of his youth, both in New York and Cincinnati, his former home.

John B, Whitehead, who has been connected with the Cataract Construction company at Niagara Falls for several months, has been appointed to an assistant professorship in the Johns Hopkins University at Baltimore. Mr. Whitehead will begin his new duties next October.

The deaths of C. W. Earle and Graff Baker, English electrical men, are announced. The former was in his sixty-eighth year and was largely interested in international telegraphic cables; the latter was but 32 years of age, but is spoken of as one of the pioneers of electric traction in Great Britain.

W. R. Mason of Chicago has been appointed agent of the Walker company for the state of Missouri, with head quarters in St. Louis. Mr. Mason is one of the best known electrical dealers in the West, and he has an especially wide and valuable acquaintance among electric railway men. His years of experience as manager and salesman and his knowlege of southern trade should prove of much value to the Walker company.

On June 2d there was a large gathering at the Calvary Methodist Episcopal church, Seventh avenue and 129th street, New York city, to witness the marriage of Miss Ida Maud Stafford and Mr. Robert Edwards. The ceremony was performed by the Rev. Dr. McChesney at eight o'clock. The bride's sister, Miss Bessie Stafford, attended her as a maid of honor. Mr. Dudley Frost was the best man. A reception followed the church ceremony at the home of the bride's parents, Mr. and Mrs. Harlow H. Stafford, 225 West 126th street. Mr. Edwards is a member of the well-known manufacturing firm of Edwards & Co. of New York. Many friends join in best wishes for their future.

ELECTRIC LIGHTING.

Robert E. McKisson of Cleveland, O., and associates, who recently obtained franchise for railway in Jackson, Miss., are now considering the erection of an electric light plant in the same place. It is proposed to combine the power and lighting plants, and $120,000 may be expended.

An electric light plant, to be operated by gasoline engines, will be installed in the Huckins House of Texarkana, Ark. The hotel is wired for 110 volts potential, and two engines and dynamos—the latter of about 100 and 200 lights' capacity each—are required. J. Huckins, Jr., is the manager of the hotel, and correspondence is solicited.

It is stated that the electric lighting of Michigan avenue from Fourteenth to Thirty-ninth streets will be accomplished by August 1st. Sixty-six arc lights will replace 300 gas lamps, and the wires will be lead-encased and placed underground in terra cotta conduit laid in a shallow trench at the east curb. Current will be supplied from the city plant at Fourteenth street and Indiana avenue.

The Eatonton (Ga.) Electric Light company has awarded the contract for the erection of its plant. A 75 kilowatt monocyclic generator is to be installed at a water power plant about three and one-half miles from the city; about 700 incandescent lights will be installed in stores and residences, and during the day 80 horse power in motors will be used for driving small manufacturing plants. Induction motors will be used for this purpose.

With the specification of the Arnold system of power station construction, with D. H. Burnham & Co. as architects, and with the whole electrical contract let to a Chicago concern, the western metropolis may be said to have something to do with the isolated plant in the new Land, Title & Trust building in Philadelphia. There will be two 40 kilowatt direct-connected dynamos with storage battery auxiliary, an electric elevator, several ventilating motors and about 1,500 incandescent lamps.

ELECTRIC RAILWAYS.

The litigation between the Knoxville Street Railway company and the Citizens' Railway company for the possession of street rights in Knoxville, Tenn., has resulted in a victory for the former.

"Illustrated Binghamton" is an attractive pamphlet published by the Binghamton (N. Y.) Railroad company "in the interest of Binghamton and its surroundings, and incidentally to boom street railroad traffic." The company hopes through the influence of this souvenir to induce excursions to make Binghamton and its resorts their objective points.

An electric road from Marseilles, Ill., to Lake Geneva is contemplated. The line will pass through Norway, Sheridan, Sandwich, Hinckley, Cortland, De Kalb, Sycamore, Genoa, Marengo, Harvard, Big Foot Prairie and Walworth before reaching Geneva Lake. The line passes through one of the richest agricultural districts in the world, and the construction will not prove very expensive.

The property and franchise of the Gettysburg Electric Railroad company was bought by a committee of the bondholders, consisting of Max Riebeneck and Luther S. Bend, for $50,000, on June 10th. The capital stock of the road was $200,000. Eight miles of track have been completed for some time, and the power house is a substantial and attractive building. The receivers were appointed in September, 1895.

The county commissioners of Crown Point, Ind., on June 23d granted a franchise to Chicago and local capitalists to build and operate an electric railway between Hammond, Crown Point and Cedar Lake. The road will make a bid for summer resort traffic to Cedar Lake, which has hitherto been held exclusively by the Monon company. When the road is completed other roads in northern Indiana will be built, giving the entire northern part of Indiana electric railway communication.

Instead of fighting each other, two steam and electric railroad companies doing suburban business in and about St. Louis have agreed to divide the business—steam in the country, electricity in the city. The agreement is between the Missouri Pacific and the Lindell electric companies, the latter being one of the most important electric roads in St. Louis, controlling over 60 miles of track. The arrangement as perfected provides for running frequent short steam trains from Meramec Highlands to Vandeventer station, three miles within the city limits and 3½ miles from the business center, The trains stop at this point, and thereby keep out of crowded yards in the vicinity of the Union station. At Vandeventer station passengers transfer to the Choteau Avenue division of the Lindell electric railroad for downtown points, or to the Vandeventer Avenue division for West End points. One free transfer will be given from either of these divisions to any other connecting division of the Lindell line. Since the construction of the electric lines into the county about two years ago, the Missouri Pacific as well as the St. Louis & San Francisco have been compelled to abandon over half of their suburban trains, owing to a decrease of passenger traffic, and now run a few local trains only, mostly in the morning and evening. The new arrangement will give the steam road an opportunity to recover part of its former suburban business.

MISCELLANEOUS.

John S. Moyer, bookkeeper and cashier of the Chicago office of the New York Insulated Wire company, has been indicted on two counts on charges of larceny, preferred by the company.

If John C. Level's plans do not miscarry, horseless vehicles will soon be running on the state reservation at Niagara Falls. Mr. Level has the lease of the van service, and he has ordered a storage battery carriage for an experiment.

Laird Clowes, the British naval expert, in an article in the *Daily Mail* of London on the Spithead review, highly praises the American use of electricity for various purposes in men-of-war, and declares that in this matter England is years behind the United States.

The trial of the case of the Eddy Electric Manufacturing company against the Chicago Athletic association resulted in a verdict of $4,100 for the plaintiff. The suit grew out of the contract for installing the original plant in the clubhouse of the Athletic association, the defendant alleging that the dynamos were defective and refusing to pay for them. Neither side is satisfied, and there may be a new trial.

The *Cleveland Leader* of June 18th said: "The Buckeye Electrical company of this city will take no legal steps in the case begun against it by the Manhattan General Construction company of New Jersey until its officials fully understand the allegations made against them in the petition filed in the United States Circuit Court. The New Jersey company claimed that the Buckeye company had infringed on the powers granted it by the Legislature, in that it had secured control of the Jandus Electrical company, and in that manner had injured the business of both the Jandus and Manhattan companies. A *Leader* reporter interviewed one of the officers of the Buckeye Electrical company yesterday on the status of the case. The official refused to talk further than to say that he and the other officials of the company did not understand the full import and details of the allegations made by the Manhattan General Construction company, and that the filing of the suit in the United States Circuit Court was a complete surprise to them. 'We expect to protect our interests,' said he, 'but as yet we have not mapped out a line of action, and we shall take no steps until we thoroughly understand the situation.'"

TECHNICAL SCHOOLS.

Columbia conferred the degree of electrical engineer on 27 graduates last month.

At the commencement of June 10th the University of Nebraska conferred the degree of E. E. on Bion J. Arnold of Chicago. The venerable Dr. Edward Everett Hale of Boston attended the exercises, and it is esti-

mated that 3,000 persoos were present. In course the University of Nebraska only confers the degree of bachelor of electrical engineering, so that Mr. Arnold's distinction is a notewnrthy one.

The University of Wisconsin regents have conferred the honorary degree of civil engineer on Edward Bates of Chicago, superintendent of bridges and construction of the Chicago, Milwaukee & St. Paul railway.

Diplomas of the Chicago Manual Training School were awarded on June 23d to 35 youog men at the commencement exercises, held in Steinway Hall. The class is the 12th which the school has graduated, the total number who who have finished the course being 600.

The Michigan Agricultural College has a school of mechanical engineering, and it is stated that good opportunities are offered at low cost, with moderate admission requirements. A catalogue will be sent on application to the institution at Agricultural College Postoffice, Mich.

The Sibley College (Cornell) prizes for excellence in mechanic arts have been awarded this year to the following-named men in the order named: H. Diedrichs, E. Tompkins, A. Harding, C. M. Eshleman and J. E. Barney. The value of the prizes in the aggregate is $100.

The committee appointed by the Board of Overseers of Harvard to visit the Jefferson Physical Laboratory has just made its report. There have been many noteworthy original investigations in the laboratory this year. Perhaps Professor Trowbridge and his associates have made the most interesting experiment on "The Energy Conditions Necessary to Produce the Röntgen Rays." A large steel grand-stand was recently erected on Holmes Field. A curious fact was soon noticed. This mass of magnetic material has caused variable disturbances in the magnetometer records of the "horizontal intensity" component of the earth's magnetism. As the grand-stand will be removed to Soldier's Field next year this inconvenience to the original investigations which are constantly being made by the director and his staff will be obviated.

Eighty-one graduates of the School of Technology of the Lehigh University of South Bethlehem, Pa., presented theses for degrees at last month's commencement. The degrees conferred were master of science, engineer of mioes, civil engineer, mechanical engineer, bachelor of science (in metallurgy), bachelor of science (in mining), electrical engineer and the degree of analytical chemistry. The thesis of C. W. Thorn, C. E., was entitled "Location and Estimate for an Electric Railway from South Bethlehem to Friedensville," while H. R. Peck, M. E., wrote of "The Design of an Electric Locomotive." The list of papers presented by candidates for the degree of electrical engineer is as follows: H. L. Bell and H. H. Seabrook, "Design and Construction of Field for a Direct Current Armature;" W. R. Binkley and R. S. Griswold, "Investigation of the Edison Chemical Meter;" C. S. Bowers and L. Diven, "Design of a Three-phase Alternator;" W. E. Brown and O. S. Good, "The Design and Economy of an Electric Lighting Plant for Lehigh University;" I. D. Fulmer and A. R. Sterner, "Construction of a Storage Battery of the Plaoté Type;" W. S. Hiester and H. S. Johnson, "Methods of Control of Street Railway Cars;" R. N. Hood, "Design of a Direct-connected Dynamo for Lighting;" A. P. Jenks, "Plans and Specifications for an Electric Railroad Between South Bethlehem and Friedensville;" C. V. Livingston and C. F. Scott, "Design of a Multipolar Railway Generator;" A. F. Loomis and C. P. Nachod, "Tests of Motor Electric Meters;" B. MacNutt and H. R. VanDuyne, "Analysis of Coal by Means of X-rays;" A. H. Serrell and P. B. Straub, "Tests of Electrically Heated Utensils;" G. L. Yates, "The Problem of Submarine Telephony."

TRADE NEWS.

M. M. Wood, the designer of Wood's railway material, has severed his connection with the Ohio Brass company of Mansfield, Ohio, to take the position of electrical engineer of the Central Union Brass company, St. Louis, Mo. Mr. Wood has a new line of overhead material which this company will soon bring out.

The story of the letting of a contract for incandescent lamps for the courthouse of Trumbull county, Ohio, is told in a neat pamphlet by the Warren Electric & Specialty company of Warren, Ohio. The corporation is fighting the lamp trust vigorously, and this is but one of the telling points it has made against that aggregation.

The Electrical Engineering & Supply company of Syracuse, N. Y., has made a general assignment. Benjamin Stolz is named as the assignee. The company dealt in electric light and railway supplies. H. C. Hodgkins was president and H. A. May secretary. The company was unable to meet the claims against it in full, and made the assignment to make payment in the best possible way. For nominal consideration, all the interest, stock and claims of the company were transferred to Mr. Stolz, who is authorized to sell everything with reasonable dispatch and convert the property into cash. Assignee Stolz will act as attorney. The list of assets or liabilities has not been recorded.

The Arnold system of power station construction is coming into increasing use in both large and small plants, as its advantages are obvious. One of the recent plants for which it is specified is that of the University of Michigan. This system is owned by the Arnold Electric Power Station company of 1540 Marquette building, Chicago.

J. M. Thomas, treasurer of the Chicago Belting company, is elated over the many large orders for Chicago belting which his company has recently secured. Noteworthy among these might be mentioned a $3,000 order which has just been received from West Virginia and an exceptionally large one secured in Denver. A 32 inch main double leather belt, furnished by the Chicago Belting company, is now being put up in the power house of the Mason City (Iowa) electric road. This plant was installed by the Western Engineering & Construction company. The above are but a few of the orders which the Chicago Belting company has now in hand. The company is making a strong bid for new business, and its excellent standing in the trade enables it to secure at least its share of orders.

It is perhaps needless to say that the Western Telephone Construction company was in Detroit for a few days last week and was decidedly in evidence in the persons of J. E. Keelyn, K. B. Miller, C. P. Platt, J. G. Nolen, W. D. Barnard and J. A. Russell. The exhibit made by the Western company was a most complete and extensive one. There was a telephone booth, also a 100 drop switchboard of the company's most improved type. This board is most compact and has mechanical self-restoring drops and the new Western automatic circuit changers. The operator, by simply rocking a little lever to and fro, can get and put the calling and the called subscriber in quickest touch, yet maintain control of the situation and thus give the quickest service. Over a dozen different sets of the instruments, together with a new long-distance transmitter, were also shown. On the whole it may be said that the Western Telephone Construction company's exhibit was one worthy of so large and aggressive a concern.

The Dennis fluorometer, which is described as a surgical adjunct of X-rays, is described in a neat pamphlet issued by the Rochester Fluorometer company. It is the invention of John Dennis, of Rochester, N. Y., and has attracted considerable attention among practitioners employing X-rays. It is the function of the fluorometer, in its relation to practical surgery, to establish with precision the location of any foreign object within the human organism which is impermeable or comparatively impermeable to the X-rays. In other words, it is the province of the fluorometer to enable observers to form an exact and certain diagnosis in cases of the presence of bullets, needles, calculi or any other substance which is comparatively more dense in its fluoroscopic shadow than the subject in which it is contained. It is also its function to provide the surgeon with absolute and reliable measurements in cases of dislocations, fractures or any abnormal conditions of the anatomy which are susceptible of reproduction in the Röntgen shadow.

BUSINESS.

The Orne Electric Construction company, Chicago, manufacturer of the Orne telephones, reports that it is compelled to run its factory day and night to fill orders.

The business offices of the Holtzer-Cabot Electric company have been removed from the former location, 92 Franklin street, Boston, to the factory building, Station street, Brookline, to which place all communications should be addressed.

The Pacific Electric company of La Crosse, Wis., will be happy to meet all electrical friends who visit La Crosse on the occasion of the convention of the Northwestern Electrical association of July 21st and 22d. This is the company that makes the well-known Espersen shade lamp.

The Rice Machinery company of 166-174 South Clinton street, Chicago, general agent for the Dodge Manufacturing company, has issued a complete catalogue of power-transmitting appliances and elevating and conveying machinery. The work is elaborate and contains much valuable information. The company guarantees to fill any contract in its line, no matter how large.

The D. A. Kusel Telephone Manufacturing company of 1105 Pine street, St. Louis, is prospering. Contracts were recently closed by it for exchanges in Fredericktown, Mo., Bunceton, Mo., Wagoner, I. T., Butler, Mo., and Troy, Mo.; and a fine business is reported from established exchanges using the D. A. Kusel instrument. Since the announcement of the Berliner decision, the company declares, it has had more business than during any similar period of time in its previous history. "Give us a Berliner decision once a month," say the D. A. Kusel folks.

The general catalogue, No. 11, of the General Incandescent Arc Light company of 572-578 First avenue, New York, is comprehensive, and shows the latest Bergmann arc lamps (open and enclosed), switches, switchboards, panel boards, outlet boxes, etc. It is well arranged, clearly printed in two colors and attractively illustrated. It is a valuable compendium for the man engaged in electric lighting.

Notwithstanding the unusually cold weather experienced all over the country during the month of May, the Electric Appliance company reports that the few days of hot weather in June started the fan business going in good shape, and gives promise of a prosperous fan season. The Electric Appliance company states that copies of its fan motor catalogue will be sent to the trade upon application. This is a complete book of all styles of fan motors.

The opportunity to keep his thriving enterprise well to the front was not lost by President John Valentine of the Valentine-Clark company, Chicago. Messrs. Valentine and Clark, although young men, are nevertheless old in the pole business. They have a host of good friends among the largest buyers of poles in the United States and especially among the telephone interests, and it is safe to say on this account that Mr. Valentine was one of the best known and most welcome visitors at the Detroit telephone convention.

The Moon Manufacturing company of Chicago appeared at the Detroit telephone convention in the person of Manager H. E. Procunier. Mr. Procunier is one of Chicago's most enterprising managers of telephone apparatus. He exhibited the new Moon terminal and distributing box. This device is employed to enclose and protect the ends of electric cables and furnishes a means for easily testing and transposing conductors. This device should be investigated by every manager of telephone exchanges interested in advanced methods.

The many friends and patrons of the Garlock Packing company will be pleased to hear of the continued prosperity of this enterprising concern. Notwithstanding the fact that business generally is not brisk, the Garlock Packing company finds it necessary to run its plants overtime to keep up with its orders. The company has now plans drawn which will greatly increase the capacity of its Palmyra (N. Y.) factory, and has already broken ground for an additional building, which, when completed, will nearly double the capacity of the plant.

Encouraging reports of good business come from the Schneider Manufacturing company of 1134 Hamilton street, Cleveland, Ohio. This concern manufactures the Gem water-motor fan, which is taking well in towns where the electric current is not supplied in the daytime and also in districts where it is impracticable to secure current to operate electric fans. The water-motor fan is proving so satisfactory that many customers have duplicated their orders; indeed some have ordered four or five times. The Schneider company thinks that electrical supply dealers might well add water-motor fans to their stock.

The new catalogue of the Triumph Electric company of Cincinnati shows all the type of apparatus made by this progressive company. There are direct-connected machines, belted units—dynamos and motors of several varieties—while the various parts are illustrated and described in detail. This company claims that the success of its apparatus is undoubtedly due to the careful attention given every detail of manufacture, and the rigid factory inspection and tests to which every machine is subjected before shipment, insuring, as is claimed, satisfactory and successful operation when erected. The catalogue is well illustrated, and several Triumph plants are shown.

Comprehensive indeed was the exhibit of the American Electric Telephone company at the recent telephone convention at Detroit. The American company was represented by President P. C. Burns and General Manager H. C. Dodge. The exhibit comprised almost every imaginable form of telephonic apparatus, including the company's express switchboard, a new departure, embracing features said to be possessed by no other board on the market. This board is claimed to be the most rapid switching device ever devised and was the center of attraction to all telephone experts interested in late improved apparatus. This board has a self-restoring drop, self-restoring ring-off and a rapid ringing device. Each drop and jack is self-contained in a hard rubber case, and can be removed and replaced in the board in less than a minute without disturbing a single connection. Each drop, too, indicates that the line is working properly. There was also exhibited late improvements in bridging telephones, adjustable arm instruments, and the American's new solid-back amplifying transmitter.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued June 22, 1897.

584,785. Electric Gas Lighting and Extinguishing Apparatus. Gottfried F. Krieger, Kiel, Germany. Application filed March 2, 1897.

An electro-magnet is included in a suitable electric circuit; an armature is held normally retracted from its magnet; an armature lever and a link connected therewith are provided with a stud working in a diametral groove in the end of the valve stem.

584,798. Burglar Alarm. Henry M. Sutton and Walter L. Steele, Dallas, Tex. Application filed October 29, 1895.

A relay has separate permanent and electro-magnets controlling a circuit closer, a signal or alarm circuit including therein the circuit closer of the relay, and an automatically operating current-changing device included in a circuit with the main-line wires and electro-magnet of the relay.

584,810. Telephone Transmitter. Russell S. Barnum, Chicago, Ill. Application filed July 9, 1896.

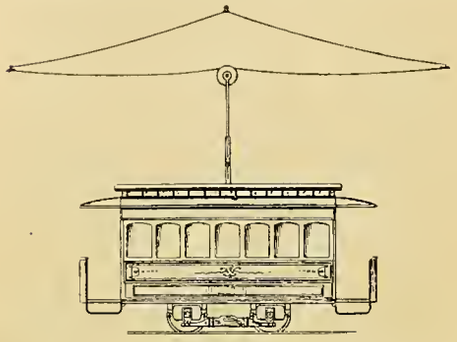
An electrode is provided with one or more cavities therein for the reception of finely divided particles of conducting material, and one or more tufts of elastic fibrous material arranged within the cavities.

584,819. Telephone Annunciator, Call Bell and Fire Alarm. Manious Garl, Akron, Ohio. Application filed April 6, 1895.

A device for a telephone for making a speaking circuit from the main office, consisting of two posts forming a part of the electric circuit between the various rooms, a sliding bar mounted between the posts, upwardly projecting contacts on the bar, upwardly projecting contacts adapted to engage the contacts on the sliding bar, a bushing in a perforation behind the contacts, a plug adapted to be inserted in the bushing to make complete electric connection between the rooms.

584,823. Combined Bracket and Insulator. George W. Mead, Shellsford, Tenn. Application filed December 21, 1896.

A combined bracket and insulator are screwed into the support, and a brace is connected to the support and the bracket.



NO. 584,911.

584,831. Trolley. William J. Smith, Gloucester City, and William G. Johnston, Woodbury, N. J. Application filed August 5, 1896.

A trolley fork, having a shank formed therewith, in which is formed a socket of rectangular cross-section adapted to fit the upper end of a pole similar in cross-section, and a spring-latch for securing the fork upon the pole.

584,843. Automatic Switch for Electric Circuits. Reginald Belfield, London, England. Application filed June 19, 1895.

A system of electrical distribution, comprising a central station and one or more sub-stations, and means located in the primary circuit at each sub-station, whereby the secondary of the sub-station transformer is cut into or out of circuit as the corresponding feeder-switch at the central station is closed or opened.

584,848. Electro-magnet. Charles P. Bostian, Milton, Pa. Application filed April 22, 1897.

An electro-magnet has one or more perforations through its core, and a rod of magnetizable material within and nearly filling each perforation, the rod or rods being insulated from the core.

584,853. Therapeutic Electric Current Generator. Edgar W. Chellis, Erie, Pa. Application filed May 5, 1897.

Cylindrically arranged field of force magnets extend around within a casing, and a relatively flat armature rotates within the field of force magnets, driven by the motor train.

584,856. Controller for Electric Motors. Harry P. Davis, Pittsburg, Pa. Application filed October 28, 1896.

The combination is described with an electric circuit, and a resistance normally included therein, of a switch and an actuating magnet for gradually reducing the amount of the resistance in circuit: means for short-circuiting the magnet when the minimum resistance is secured, and a second magnet for maintaining the last-named condition until the circuit is interrupted.

584,867. Arc Lamp Carbon. Theodore M. Foote, Chicago, Ill. Application filed February 17, 1896. Renewed April 21, 1897.

This carbon has a longitudinal groove, including the center or core of the carbon, so as to penetrate into the crater, and apex formed at the end of the carbon.

584,868. Telephone. John T. Gent, Alwyn W. Staveley and Isaac H. Parsons, Leicester, England. Application filed December 11, 1895. Patented in England November 11, 1892.

A variable resistance is employed, consisting of a suitable conducting material, a pivotally or axially mounted containing-receptacle for the material, a rack secured to the receptacle, a pawl adapted to engage the rack, and a pivoted telephone-supporting lever carrying the pawl.

584,873. Electric Railways. Frederic W. Hunter, Cranford, N. J. Application filed November 17, 1896.

Two widely separated conductors of the same polarity are arranged, one upon each side of a vertical plane through the slot, and suspended within the conduit so as to form a clear space all around them; a depending current-collecting device extends from the car through the slot of the conduit and terminates in a roller located wholly within the conduit journaled upon a transverse axis, and making rolling contact simultaneously with both conductors.

584,879. Coin Freed Electric Meter. George Knight and George Ellis, Southsea, England. Application filed November 14, 1896. Patented in Belgium November 26, 1896, and in Canada December 12, 1896.

There is connected to the receiver a reservoir provided with a float which is raised when the fluid is forced out of the receiver into the reservoir, contact devices operating to close the circuit while the float is descending, a solenoid included in the circuit, and a valve operatively connected with the solenoid and controlling the passage of fluid from the reservoir back into the receiver.

584,911. Electric Railway System. George Westinghouse, Jr., Pittsburg, Pa. Application filed November 26, 1892.

The claim is given: In an electric railway system, the combination of a continuous trolley wire, a contact cylinder having a plurality of grooves and making uninterrupted engagement with said wire, a fixed vertical support for said contact cylinder, a car on which said support is mounted, and yielding supports for said trolley wire, each consisting of a centrally supported sustaining wire, and attachments between the ends of said sustaining wire and said trolley wire.

584,912. Brush Holder for Dynamos. James H. Yearsley, Philadelphia, Pa. Application filed April 8, 1897.

Features of this invention are: A box in which the brush is adapted to be fed toward the commutator, two arms pivoted at one end to the box and having their free ends resting upon the brush, a cross-piece or bridge uniting the arms, and a spring adapted to depress the bridge toward the box, whereby the arms are caused to press upon the brush with a constant and uniform pressure.

584,918. Electric Railway Trolley. Edward M. Bentley, New York, N. Y. Application filed June 4, 1896.

The pivoted arm is provided with a stop for limiting its upward movement, and a movable end section thereon is adapted to bear against the under side of the conductor and make contact therewith.

584,936. Electric Conductor. Ira W. Henry, New York, N. Y. Application filed September 15, 1896.

A submarine conductor is composed of a conducting core inclosed within a sheath of waterproof insulating material capable of preserving its insulating properties at great depths in water, an inclosing sheath of fibrous material, and an armor composed of non-magnetic wires side by side.

584,945. Automatic Coin Actuated Machine. Remigio Lo Forte, New York, N. Y. Application filed January 11, 1896.

A coin-actuated motor rotates a shaft, and an electric contact is controlled by the coin-lever.

584,957. Electro-therapeutical Apparatus. Francis J. Patten, New York, N. Y. Application filed September 30, 1896.

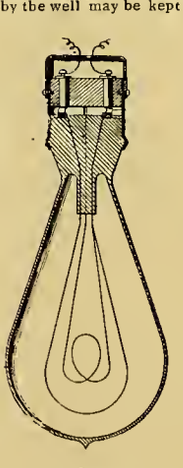
A source of electric energy is provided, leads therefrom to the terminals of a current-reversing apparatus adapted to transform the current to a uniformly and gradually alternating unbroken current that leads from the current-reversing apparatus to devices for applying the transformed current to the human subject.

584,983. Electric Arc Lamp. Antoine Bureau, Brussels, Belgium. Application filed January 27, 1897. Patented in England August 9, 1893.

Claim one is given: In an arc lamp, the combination with the frame and the chain connecting and operating the carbons, of a grooved pulley supporting said chain, a fulcrumed frame carrying said grooved pulley, an iron core on each side of the fulcrumed frame, a wire coil on one of said cores, two differentially wound coils on the other core, an armature supported on one end of said fulcrumed frame and at right angles to said cores and adapted to be controlled thereby, a brake-wheel pivotally secured in the fulcrumed frame and parallel to the grooved pulley, gear connections between said brake-wheel and the grooved pulley, and also carried by the fulcrumed frame, a brake fulcrumed in the frame and insulated therefrom and metallically connected with the differentially wound coils, and metallic connections between the wire coils and the brake-wheel.

585,019. Apparatus for Electric Thermal Treatment of Metals, Ores, etc. George D. Burton, Boston, Mass. Application filed November 30, 1896.

A main tank is adapted to receive the electrolytic solution and is provided with a well; a second tank is provided with a fluid conductor adapted to conduct the solution to the well, whereby the well may be kept constantly full to overflowing.



NO. 585,137.

585,026. Tieless Insulator. Robert Deléry, New Orleans, La. Application filed January 11, 1897.

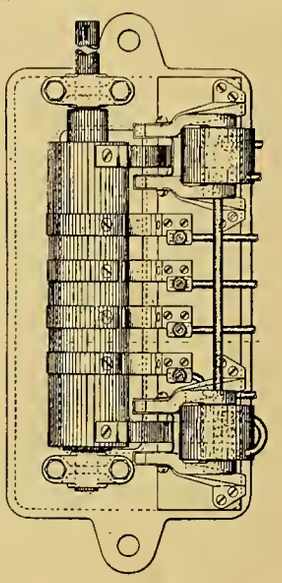
This insulator comprises two sections, one of which is provided with a screw-threaded attaching bolt, and an annular flange of less diameter than the section, and having a vertical wire-receiving slot formed therein, and screw-threads formed upon both its inner and outer walls, and the other section having a screw-threaded socket adapted to fit over and engage the screw-threads of the annular flange, and a screw-threaded stud adapted to fit into the flange and engage the screw-threads upon the interior of the same.

585,030. Magnetic Circuit Breaker. Walter E. Harrington, Philadelphia, Pa. Application filed December 26, 1895.

Claim is made for the combination with a switch and contacts of a solenoid coil and core vertically movable therein, a switch-arm approximately parallel to the core when the switch is closed, and an independently movable means above the core for communicating the force of the impact of the movable core to the switch-arm to throw it out of contact.

585,040. Method of Melting Iron by Means of Electricity. Carl G. P. De Laval, Stockholm, Sweden. Application filed October 3, 1892. Patented in Sweden March 8, 1892; in England March 8, 1892; in Germany June 12, 1892, and in Norway September 7, 1892.

Features described are a transverse bridge of refractory material, cavities at the bottom of the furnace on each side of the bridge, and fusible pole-pieces received by the cavities.



NO. 584,856.

585,047. Conductor for Underground Electric Railways. Charles Petersen, San Francisco, Cal. Application filed January 29, 1897.

A subway for electric conductors, consisting of a tunnel formed by angle plates, the upper edges of which approach each other to form a slot, and the lower edges have flanges adapted to secure them to the supporting structure, supplemental angle plates fitting the adjacent edges of the main channel irons, and stay-bolts connecting the outer edges of the supplemental plates with the exterior bottom flanges of the main channel irons.

585,051. Apparatus for Electro-deposition of Metals. Alfred S. Smith, Thomas A. Smith, Roland J. Smith, Sydney Smith and Thomas Deakin, Walsall, England. Application filed August 27, 1896.

In an electrolytic tank furnished with anodes there is the combination with a perforated drum, of a vat for the electlyte, conducting devices for suspending the drum therein on a conducting axis, separated contacts loosely mounted on a sleeve inclosing the axis, means for rotating the drum, and negative and positive wires, the former connected to the device supporting the anodes, and the latter to the support for the separated contacts.

585,072. Auxiliary Fire-alarm System. Richard E. Alexander, Yonkers, N. Y. Application filed October 31, 1895.

There is the combination of a main circuit signal box, comprising a let-off magnet, a testing mechanism and auxiliary boxes, a normally closed circuit containing the testing mechanism and auxiliary boxes in series, and a second closed circuit controlled by the first, including the testing mechanism and the let-off magnet.

585,120. Electric Locomotive. Louis T. Pyott, Philadelphia, Pa. Application filed November 17, 1896.

A framework is described, having central supports with spring pockets therein, springs in the pockets, a central band upon the springs, an axle within the band, and side-bearing wheels upon the axle and outside of the band.

585,137. Multiple Filament Regulating Incandescent Lamp. Clarence Truitt, Columbia, Mo. Application filed February 15, 1897.

The socket has spring contacts, and arc-shaped terminal plates are united to the lamp base to be exposed for contact with the springs, and double filaments, each having one end attached to a common terminal plate, and the other ends of the filaments attached respectively to other independent terminal plates.

585,138. Electrical Alarm for Door Locks. Paul V. Vandevelde, Corona, N. Y. Application filed April 6, 1897.

The device comprises a lock or latch-casing, a longitudinally movable latch-bolt mounted therein, an insulated spring connected with the casing adjacent to the rear end of the latch-bolt, and adapted to be struck thereby, and an electric alarm in circuit with the spring and the casing, the casing being also provided with a tumbler, by means of which the latch-bolt is operated, the tumbler being provided with arms which operate in opposite direction, and an insulated fork mounted in the casing, the sides of which are adapted to make contact with the arms of the tumbler, the fork being also in the circuit.

585,160. Method of and Machine for Electric Welding. Richard D. Eyre, Johnstown, Pa. Application filed October 30, 1896.

The method of electric welding set forth consists in heating the ends of the articles to be welded by a suitable supply of electric current, upsetting the heated ends and compressing the upset metal as it is formed with a pressure largely in excess of that required to form a weld.

11,613. Insulated Support for Contact Rails. Augustus Hanson and James R. Chapman, Chicago, Ill. Application filed October 31, 1896.

An insulator for the contact or third rails of an electric railway, comprising a separate support adapted to be secured to the rail by rotation, and a body of insulating material separating the rotating support from the road structure.

Western Electrician.

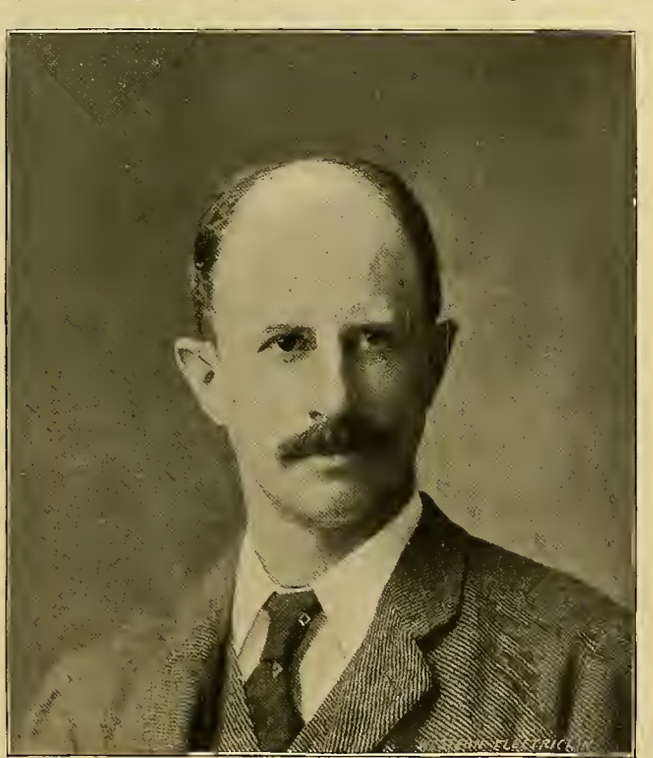
EVERY SATURDAY.

Vol. XXI. CHICAGO, JULY 10, 1897. No. 2

Henry B. Stone.

On July 1st Henry B. Stone, for seven years the most influential exponent of the Bell telephone interests in the West, resigned the presidency of the three companies with which he was connected. He intended to devote some time to travel and recreation before again plunging into that industrial activity for which his talents so conspicuously fitted him for leadership. He journeyed to his summer home in Massachusetts, near New Bedford, to celebrate Independence Day with his family and to rest before putting into execution his plan of travel. There, at the seashore, he met death on July 5th, in the full prime of a useful manhood, by the unexpected explosion of a bomb in a firework display.

The manner of death was distressing. The newspapers give the account. Mr. Stone was entertaining a party of friends with a display of fireworks. The principal piece was a mine, which was so devised as to scatter, when exploded, a number of vari-colored tissue-paper animals and make them fly through the air. The spark on the fuse appearing to have gone out, Mr. Stone picked up the piece to relight it. While holding it close to his face the bomb exploded. The concussion caused instant death. The skull was fractured and the face and body mutilated by the explosion. Mrs. Stone, with the two sons and two daughters of the family, were, with the assembled guests, witnesses of the terrible accident, which occurred late in the forenoon. The physician who was summoned with horror-stricken haste could do nothing. The funeral services were held in New Bedford, Mass., at the home of Mr. Stone's mother, on July 8th. A number of Chicago gentlemen attended.



HENRY B. STONE.

Mr. Stone was a man of great energy and ability, and he was remarkably successful in the direction of affairs. Perhaps no man in Chicago had a higher reputation for keen business sagacity, for quick insight, for well ordered judgment. His career is interesting and instructive. The son of a leading lawyer in his native town, Henry B. Stone was born in 1852 in New Bedford, Mass. He was educated at Andover Academy and at Harvard University, graduating from the latter institution with a bachelor's degree in arts. The young collegian had an aptitude for practical affairs, for mechanics, and he secured employment in a machine shop of the Waltham Watch company, afterward working in the Boston Ordnance Works. His next step in life proved to be an important one, for by it he entered the railroad business, in which he made a commanding success. He went west and secured a position with the Chicago, Burlington & Quincy company. He began at the bottom of the ladder, in the machine shops at Aurora. He worked as a mechanic at first, carrying his own dinner-pail, and living in the same manner as his fellow-workmen. But he had an unusual aptitude and applied himself unceasingly. Step by step, this college-bred mechanic worked his way up, until he became general manager and second vice-president of the great Burlington system. During the important locomotive engineers' strike of 1888 Mr. Stone fought the men resolutely, and he came out of the grim contest victorious. The struggle engrossed the attention of the entire country, and it made Mr. Stone famous. It is thus described by a writer in the *Chicago Times-Herald:*

As soon as the strike was declared by the engineers Mr. Stone took up the gauntlet and displayed consummate ability in meeting their measures at every point. He at once opened recruiting offices in the eastern states, and secured the services of several hundred engineers formerly in the employment of the road. In order to improve their skill he opened a school, where the use of the air brake and other similar appliances was taught. So great was his interest in the contest that he was not willing to be out of reach of the dispatches at night, and for a long time he slept on a cot in his office. It was largely due to his masterly judgment that the final result of the year's fight was a victory for the road—a victory so complete that, when several years later [in 1894] the great railroad strike under Debs was inaugurated the Brotherhood of Locomotive Engineers showed little inclination to participate.

Mr. Stone resigned his position with the railroad company soon after the settlement of the strike and spent some time in travel. In 1890 he cast his lot with the Bell telephone interests, and up to July 1st, as has been stated, his was the commanding figure of the Bell company in the West. He was president of the Chicago Telephone company, the Central Union Telephone company and the Bell Telephone company of Missouri. He is believed to have known more about the inside management and policy of the American Bell Telephone company than any other man in the West, and his counsel was highly esteemed in the inner circle in Boston. He was not, of course, a telephone pioneer, like the late F. G. Beach, but his marvelous executive ability and far-reaching business generalship made his services of the greatest value to the western telephone companies. When he announced his resignations he was entreated to remain, but he persisted in refusal. Perhaps his retirement may be considered significant of the changed conditions of the telephone industry. At any rate, a gentleman who was on terms of close intimacy with Mr. Stone makes this statement: "He resigned because he felt that he had completed the organization of this work. He could not bear to become a mere operating man. His ambitions, which were about to be gratified, were far higher than such a life could bestow; and if anyone ever had a right to entertain ambition, he had, judging by the marvelous record he had made by his forty-fifth year, when he died."

Mr. Stone had much to do with the building of the World's Fair. He was the chairman of the committee on grounds and buildings, which was the real body that constructed the exposition, and thus, while he held that place, he was, perhaps, the most important officer of the local directory. He co-operated sympathetically and intelligently with Mr. Burnham, the chief of construction, and was, indeed, one of the strongest men in the body of notable men that formed the governing board of the Chicago corporation.

Mr. Stone was a member of the Chicago club and of several other social and literary organizations. For many years he had made his home in Chicago, and, a type of a high standard of American citizenship, his death is a distinct loss to the community. A wife and four children are left.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

The Iowa Telephone company of Burlington, Iowa, has reduced its rates for party lines to $8 and $14 for residences and business houses. Rates for the selective service four-party line are $15 and $20 for residences and business firms.

The Fairmont Telephone company has extended it lines to Jackson, Minn., and may extend to Lakefields soon.

The Cedar Valley Telephone company will extend its system from Swaledale to Rockwell, Iowa.

The Viroqua Telephone company has been granted a telephone franchise at Viroqua, Wis., and proposes to have a local exchange in operation by August 1st.

The Home Telephone companyof Fairfield, Iowa, has let contracts for installing an exchange.

The Northwestern Telephone Exchange company will extend its line from Grafton, N. D., to Winnipeg, Man.

W. W. Pritchard of Spirit Lake, Iowa, and others have begun work on a telephone line from Dakota City to Wayne, Neb.

The Minneapolis council committee cannot "get together" with the Mississippi Valley Telephone company on the terms of a franchise, and the present outlook is dubious for the success of the project.

The strike of the linemen of the Mutual Telephone company in Des Moines, Iowa, for a raise in wages has been terminated by the men's demands being acceded to.

The telephone exchange at Devil's Lake, N. D., has been closed for lack of patronage.

The Bell Telephone company of Missouri, with offices at St. Louis, has filed with the secretary of state a certificate of increase of capital stock from $400,000 to $2,000,000,

Opportunity for American Capitalists.

English capitalists make investments in Mexico far larger than those of American capitalists. The former are at this time engaged in the construction of four or five new railroad lines. They are putting millions into manufacturing plants, for which the Mexican government is always ready to make concessions. They ship to Mexico vast quantities of English-made machinery. They make large investments in Mexican lands and in haciendas. They hold a large portion of the public debt of the country, from which they draw interest. England makes money out of Mexico, and a very great deal of it, though the Mexican republic borders upon the American republic, from the Gulf of Mexico to the Gulf of California.—New York *Sun*.

It might be added that the people of Mexico are anxious to deal with Americans and wherever possible they give the preference to this country. At least this has been the experience of American electrical concerns which have had dealings with the people of Mexico, yet it must be admitted that the field is not worked as thoroughly as it should be even by the electrical companies.

Design and Construction of Electric Power Plants.

By Bion J. Arnold, M. S.

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Part IX.

Storage Battery Auxiliaries.

A storage battery or accumulator is desirable as an adjunct to an electric power station in certain cases. In European practice storage battery auxilaries are common, but in this country their introduction seems to have been slow. Patent litigation between rival manu-

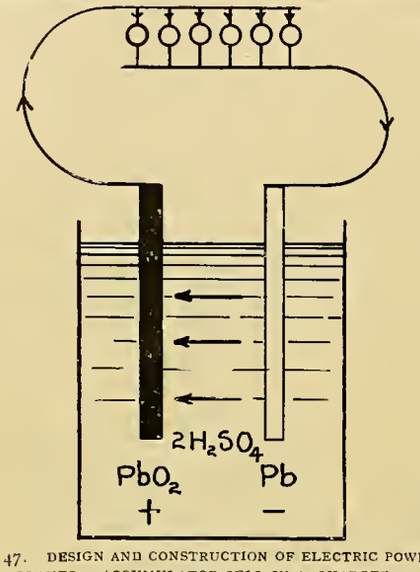


FIG. 47. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—ACCUMULATOR CELL IN A CHARGED CONDITION DISCHARGING.

facturers has had much to do with our tardy progress, although the failure of numerous poorly constructed and unintelligently operated installations has had the natural result of creating a quite general impression that storage batteries are expensive and undesirable. A number of large and successful installations made during the last few years has done much, however, to dispel this predjudice against batteries, and a growing confidence in their use is noticeable among central station engineers. It is, therefore, reasonable to predict that in a few years accumulators in central station practice will be as common in this country as they are to-day in Europe. As no part of the power station requires more careful consideration in its selection than a storage battery, it is important that the designer of a power plant shall thoroughly understand the principles underlying the operation of an accumulator and the limitations which control its successful installation.

The chemical theory of the common lead accumulator may, for our present purpose, be briefly disposed of.

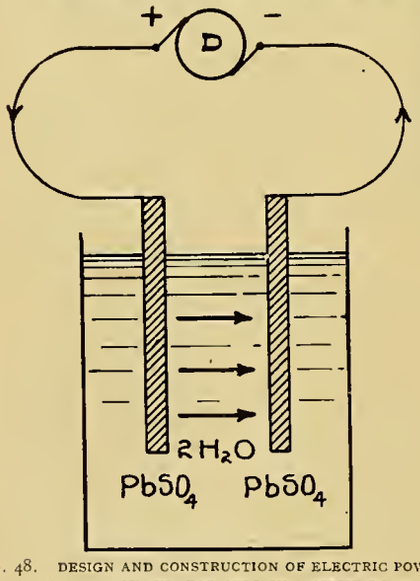


FIG. 48. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—ACCUMULATOR CELL IN A DISCHARGED CONDITION CHARGING.

The real reactions taking place in a battery cell while being charged and discharged are quite complicated, but for all practical purposes the probable chemical changes may be represented by the symbols shown in Figs. 47 and 48.

Fig. 47 represents the cell in a charged state. The cell shown consists of two plates of lead in an electrolyte of dilute sulpburic acid (H_2SO_4). The surface of the positive plate is covered with a coating of peroxide of lead (PbO_2), while the surface of the negative plate is pure lead (Pb) in a spongy condition. When the positive plate is thoroughly peroxidized the cell is said to be charged, and at this point has its highest electromotive force. If, while in this condition, the plates of the cell are connected through any device for using current, as shown in Fig. 47, a circuit will be completed. An electromotive force will be set up between the plates, which will cause a current to pass in the direction shown by the arrows and thus do useful work; the cell is then said to be discharging. As the discharge continues, the coating upon the two lead plates gradually changes its chemical composition, until, when the cell is completely discharged, we find them both in the same condition, as indicated by the symbols in Fig. 48. Here we see that the sulphur radical of the sulphuric acid has entered into combination with the coating of "active material" upon each of the plates by a double sulphating process, forming lead sulphate ($PbSO_4$). It will be noticed that this action reduces the density or specific gravity of the electrolyte. These changes may be indicated by symbols as follows:

CHARGED.				DISCHARGED.		
Positive plate	Electrolyte	Negative plate		Positive plate	Electrolyte	Negative plate
PbO_2	$+ 2H_2SO_4 +$	Pb	$=$	$PbSO_4$	$+ 2H_2O +$	$PbSO_4$

When it is desired to recharge the cell the plates are attached to a source of supply, as shown in Fig. 48, and the current sent through the cell in a direction opposite to that of the current passing through it when discharging. This charging current reverses the chemical reactions which took place upon the discharge, and at the end of the charge the plates and the electrolyte are restored to their original condition.

The action of an accumulator is thus seen to be entirely a chemical one, and the cell does not, therefore, actually store or retain electrical energy.

The changes in the electromotive force between the elements of each cell of a battery during a cycle of charge and discharge are shown graphically in the curves of Fig. 49. When fully charged and the cell is still in the charging circuit the voltage is about 2.5 per cell, but if immediately discharged this voltage drops rapidly for the first few minutes, and thereafter gradually, as shown by the lower curve, until it reaches a value of 1.8, which value is usually taken as the lowest practical limit of electromotive force, as it would be injurious to carry the discharge beyond this limit. Upon opening the circuit at the end of a discharge the electromotive force of the cell rapidly recovers, and in a few moments will stand at about two volts. Upon charging the electromotive force rises rapidly, and then more gradually, as shown by the upper curve (Fig. 49), until it reaches a point near the end of the charge, when it again rises more rapidly. There is little to be gained by prolonging the charging beyond this point in regular work, as the bending over of the curve indicates that the charge is complete. If the charging current is continued the electrolyte assumes a milky appearance, due to the evolution of free hydrogen and oxygen from the decomposition of the water of the electrolyte; and when the electrolyte assumes this appearance it may be taken as an indication that the cell is completely charged, and any further charge would represent the loss of just so much energy.

It is important to notice the limits of voltage, as shown in Fig. 49, between which each cell works, because a "battery" consists of a number of cells in series, and the number of cells in the battery will be determined by the average voltage of each cell composing it. If the battery is working on a 110 volt lighting system, for instance, the lowest voltage of the entire battery at the ends of the discharge must be 110 volts, and the number of cells in the battery would be determined by dividing 110 by 1.8 (the lower limit per cell already mentioned), which would give 61 as the number of cells required. At the beginning of the discharge the cells would have an average voltage of 2 1, and thus but 53 cells would be required to maintain the 110 volts required for the system, so that in this case eight cells would be held in reserve as regulating cells to be cut into service as the battery discharged.

Internal Resistance.—The changes in the internal resistance of the cell during a complete cycle present some peculiarities worth noting. The curve shown in Fig. 50 is typical of a number of curves prepared by Messrs. Borst and Woolfenden at the University of Michigan, showing the internal resistance of a number of cells at various rates of charge and discharge. As might be expected, the formation of sulphate upon the plates during discharge caused the internal resistance to be much higher at the end than at the beginning of the discharge, but immediately upon opening the circuit this resistance dropped to about its original value. During charge, also, the internal resistance rose, dropping again at once on breaking the charging current. It is important to keep the internal resistance of the cell as small as possible, not only to reduce the C^2R loss, but also to make the drop in voltage at times of heavy discharge as small as possible.

Specific Gravity of Electrolyte.—The change in the density of the electrolyte has already been noted. This is shown more fully in the curve of Fig. 51, which is plotted from the observed specific gravity of the electrolyte of a cell while being charged and discharged. It will be noticed that the density of the solution gradually increases on charge from 1.175 to 1.210 and correspondingly decreases upon discharge. The density of the electrolyte varies slightly with the type of cell, and as it has an influence upon the electromotive force of the cell it is important that it should be kept within the limits determined by the manufacturer.

The variation in the density of the electrolyte forms one of the surest indications of the condition of the cell. It is possible for the cell to gas, even if it is not completely charged, and if its internal resistance increases through any cause the voltage at the terminals of the cell will be correspondingly high; thus neither of these indications is always reliable for determining when the cell is charged. But if the circulation of the electrolyte in the cell is good, the reading of the hydrometer showing the density of the solution will furnish a sure guide as to the amount of charge in the cell.

Rate of Charge and Discharge.—It will be noticed that in the curves which have been referred to the average time of charge and discharge has been about eight hours. It is possible to charge or discharge a battery in a longer or in a shorter time than this. To charge with a smaller current for a longer period would simply be a waste of time without any corresponding advantage, while too large a current, either on charge or discharge, tends to shorten the life of the plates. The period of time during which a battery is charging or discharging is known as the "rate" of charge or discharge. For instance, a battery discharging in eight

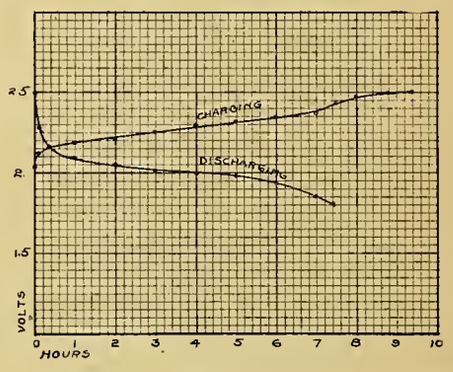


FIG. 49. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—VARIATION OF VOLTAGE OF AN ACCUMULATOR CELL.

hours' time is worked at an "eight-hour rate," while one which delivers all its current in one hour is discharged at a "one-hour rate"—the latter being considered as the higher rate. Present practice seems to have determined upon the eight-hour rate as the normal rate of discharge, and when the capacity of a cell is given, if the rate at which it discharges is not mentioned, the eight-hour rate is usually to be understood, although until recently it was customary to call a ten-hour rate the normal one, and some manufacturers still adhere to this as their standard.

Capacity.—It may be well to define the meaning of the term capacity as applied to storage battery practice. The capacity of a dynamo is determined by the rate at which it produces electrical energy without excessive heating of its parts, but with an accumulator the term "capacity" means not the "rate" but the total quantity of electrical energy which it can deliver during the period of one discharge; that is, it is the rate multiplied by the time. The capacity of a battery may be expressed either in terms of ampere-hours or in kilowatt-hours. If the ampere-hour rating is used, it means that the capacity of the battery is determined by multiplying a certain discharge in amperes by the time during which that discharge can be maintained by the cell without allowing its voltage to fall below the limit already mentioned. The term "ampere-hour capacity" is the one most frequently used, but it is not as exact as the kilowatt-hour rating, as it fails to take into account the variation of voltage during discharge. The capacity

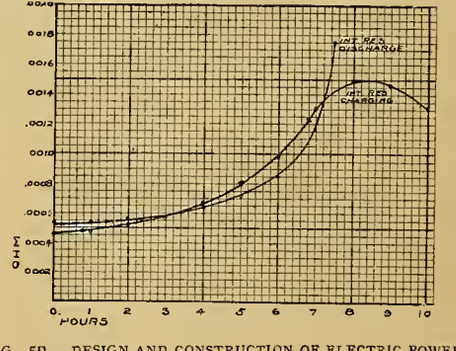


FIG. 50. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—VARIATION OF INTERNAL RESISTANCE OF AN ACCUMULATOR CELL.

of a battery on the kilowatt-hour basis is determined practically by taking the discharge in amperes and multiplying it by the average voltage and the time of discharge and dividing the product by 1,000. If both the current and the voltage are constantly varying during the discharge, the kilowatt-hour capacity is obtained by taking the sum of the products of simultaneous readings, taken at equal intervals of time, of the current in amperes and the pressure in volts multiplied by the time in fractions of an hour between readings and dividing by 1,000.

The capacity of a battery depends upon the rate at which it is charged or discharged. If it is charged and discharged at an eight-hour rate it will have a certain capacity. If it is charged and discharged at a greater than an eight-hour rate (in three hours, for instance), its capacity becomes less. The battery will have a slightly greater capacity if worked at a less than an eight-hour rate, but the variation in capacity is much more marked, as the cell is worked above the normal rate rather than below it. Fig. 52 shows the variation

in the capacity of an accumulator with a change in the rate of discharge. If the capacity of the cell when discharged at the normal eight-hour rate be taken as 100, it will be seen by the curve that at a one-hour rate only one-half as much energy can be recovered from the accumulator, while at a three-hour rate it will have but 75 per cent. of its normal capacity. If charged at the eight-hour rate and discharged at the one-hour rate, it is very evident that there would be considerable loss in efficiency, and this condition of operation is therefore to be avoided. If the battery is both charged and discharged at the one-hour rate, however, the same loss of efficiency does not result, contrary to the usual supposition, and as far as excessive loss of energy is concerned, there is little reason why the batteries should not be worked at this rate.

The actual capacity of a given accumulator at any rate of charge and discharge is determined by the amount of active material exposed to the action of the electrolyte, and as it depends upon the construction of the plates it will vary slightly with different types of cells, but, allowing for the portion of the plate which is used for mechaoical support only, a fair average may be taken as about one-third ampere-hour for each square inch of plate; that is, a battery having a capacity of 800 ampere-hours at the normal rate would have an area of positive plates (figuring both sides) equal to about 2,400 square inches. There is always one more negative plate in a cell than there are positive plates, in order to have the entire area of all the positive plates effective, as the chemical changes are more active upon the surface of the positive plates than upon that of the negative plates. The outside plates of an accumulator are therefore both negative, and the surface of these plates not opposed by a positive plate may be considered as inactive.

The normal ampere-hour capacity per pound of plate varies also with the construction of the plates and with the character of the service for which they are built. It seldom exceeds four ampere-hours per pound of element (plates only) in the largest sizes of central station

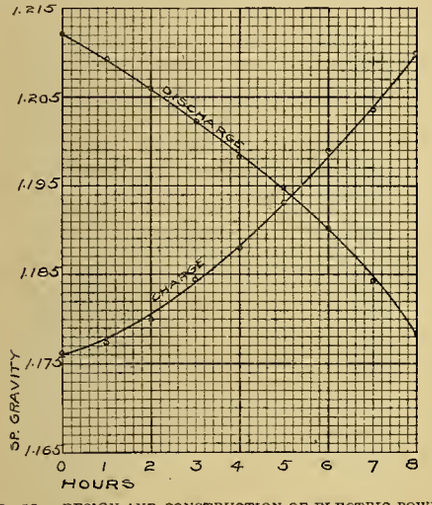


FIG. 51. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—VARIATION OF SPECIFIC GRAVITY OF ELECTROLYTE.

batteries, and for small cells will average nearer three. It is desirable that a battery should have a low ampere-hour capacity per pound of plate, and too many mistakes have been made in the past by manufacturers in an effort to reduce the weight of the accumulator per given output. This error results in an early destruction of the plates from overwork.

To obtain any given capacity, then, it is simply a question of providing an ample area of plates. Mechanical reasons will dictate the relation between the number and size of the plates. Batteries of any reasonable capacity can now be obtained commercially, and accumulators having a capacity of 4,000 to 6,000 ampere-hours capacity are quite common, and one of 10,000 ampere-hours has recently been installed.

Cost.—As the capacity of a battery depends upon the rate of discharge, we may expect to find the cost varying also with the rate. The cost per kilowatt-hour capacity at different rates is shown in Fig. 52. As a starting basis $50 per kilowatt-hour at the normal rate of discharge was taken as a fair figure upon which to base estimates at the present time. It is believed that this figure will cover the entire cost of installation of the battery, with all switchboards, wiring and accessory apparatus, but not the building. The value of the ordinate at any other rate will give the cost per kilowatt-hour capacity at that rate. Thus a battery discharging at a four-hour rate would cost $60 per kilowatt-hour, and one discharging at a one-hour rate would cost $100 per kilowatt-hour.

Efficiency.—The efficiency of a battery upon discharge depends very largely upon the immediate previous history of the cells, not only during the preceding charge, but also during the previous cycle of charge and discharge. For a battery which is charged and discharged continously at the same rate, the watt-hour efficiency will be at least 75 per cent., and may under good management be as high as 80 per cent. The former figure may be safely used in designing a plant with a storage battery auxiliary. The ampere-hour efficiency is sometimes given, but as this figure does not take into account the variation in voltage during either the charge or discharge it has little meaning, and as it is always higher than the watt efficiency it is liable to be misleading. The results of a capacity and efficiency test are shown in Fig. 53, in which the upper curve represents watts in charging and the lower curve watts in discharging. The area below the lower curve divided by the area below the upper curve gives watt-hour efficiency, which, in this case, was found to be 73.6 per cent. Considering that the battery was new and had been working on variable service just previous to the test, this figure is fairly satisfactory. The ampere-hour efficiency at the same time was found to be 90 per cent., showing the difference between ampere and watt efficiency already mentioned. This battery after having been charged

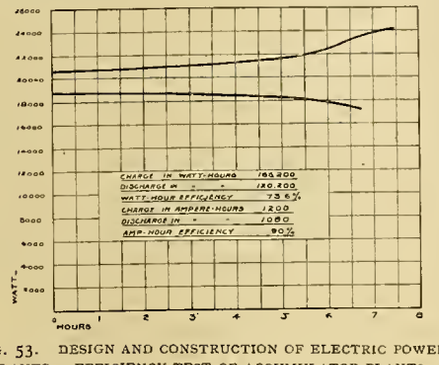


FIG. 53. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—EFFICIENCY TEST OF ACCUMULATOR PLANTS.

and discharged from 40 to 50 times would show a watt efficiency of 80 per cent.

Applications.—The advantages to be gained by installing a storage battery as an auxiliary to a generating plant can be shown in no better way than by taking a number of cases in which their use has been successful.

1. Carrying Light Loads.—Fig. 54 shows the discharge curve of the battery installed in the Chicago Board of Trade. It will be seen that the battery in this case has a capacity sufficient to carry the entire load upon the plant from 11 P. M. until seven o'clock next morning, allowing the generating plant to be shut down for eight hours each day. To have carried this load upon the generating machinery direct would have either involved the operation of one of the units at a very small per cent. of its capacity, and therefore at very poor economy, or the installation of a smaller unit, and in either case the services of an engineer and fireman would have been necessary. The curve showing the voltage of the battery is placed beneath the ampere discharge curve. In this plant it is desirable not to allow the switchboard voltage to drop much below 124 volts. It will be noticed that at 11 P. M. the voltage of 62 cells was 125, but this had dropped to 124 by midnight, when another cell was cut in, raising the voltage by about two volts. Two other cells were cut in during the night, and at seven o'clock, with 65 cells in circuit, the voltage stood at 123½, or about 1.9 volts per cell, which indicates that the battery was not nearly discharged.

In deciding upon the size of a battery to carry a load similar to that shown in Fig. 54, two considerations must be taken into account—the ampere-hour capacity and the maximum rate at which the battery is to charge or discharge. Sometimes one consideration will determine the size, sometimes the other; occasionally both. In this particular case the discharge continued over a period of eight hours, and the total discharge was 912 ampere-hours or an average discharge for eight hours of 114 amperes. A battery having a capacity of 1,000 ampere-hours at an eight-hour rate would have been ample

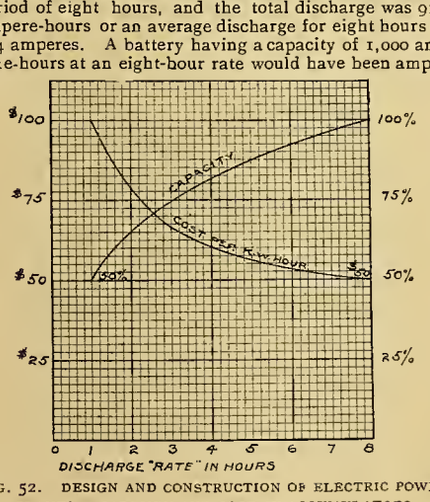


FIG. 52. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—CAPACITY AND COST OF ACCUMULATORS AT DIFFERENT RATES OF DISCHARGE.

for this particular night, but on account of this load being increased at times a 1,400 ampere-hour battery was installed. A battery of 1,000 ampere-hours' capacity would have a normal discharge of 125 amperes, and it will be noticed that during the first hour only is the required discharge much above the normal. It is always well to provide a battery of such a capacity that the maximum discharge will not be greater than that which the battery is capable of maintaining for one hour. In this case a battery of 1,000 ampere-hour capacity at an eight-hour rate will be seen from the curve of Fig. 52 to have a capacity of 500 ampere-bours at a one-hour rate. The maximum discharge required of the battery under consideration is only 150 amperes, and as this falls well within the limit of 500 amperes, no capacity need be added to our estimate to take care of the maximum rate of discharge.

2. Reducing Fluctuations.—Fig. 55 (page 18) is a five-minute section of the day load diagram of the Chicago Board of Trade plant and shows the use of the same battery in reducing the fluctuations caused by elevator and motor service.

It may be well at this point to distinguish between the term "variations" in the load and the term "fluctuations." Fig. 54 shows the variations in the demand during the night, the variation in the load between three and five o'clock being caused by the janitors dusting, and each night the load shows about these same variations both in time and amount. The dotted lines of Fig. 55, on the other hand, indicate the fluctuations in the load caused by the starting and stopping of the elevators. The maximum amount of these fluctuations may be predetermined, but the time at which they will occur can hardly be predicted. A "variation" in load, then, is a gradual increase or decrease, while a "fluctuation" is a sudden change in the demand for current. The fluctuations on an electric railway plant will be similar to those shown in Fig. 55, though, as the number of cars upon the line increases, the fluctuating effect, due to the starting of one car, becomes less noticeable, as an increase in the number of working units tends to even the load.

In Fig. 55 the diagram was plotted from readings taken every five seconds and represents the conditions under which a 75 kilowatt constant potential generator operated with a service consisting of four electric elevators and an additional load of about 500 amperes distributed to arc and incandescent lamps and motors used for ventilating purposes. The unbroken line represents the actual load upon the generator, while the dotted line

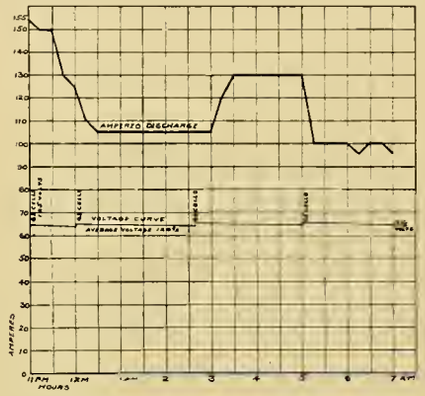


FIG. 54. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—DISCHARGE CURVE OF BOARD OF TRADE BATTERY.

represents the load which would have been upon the generator if there had been no storage battery auxiliary. That part of the dotted load line above the unbroken line represents the discharge of the battery—the part below shows when the battery was charging. It will be noticed that of the current required to start the elevators fully two-thirds was furnished by the batteries. Of the other third, which was furnished by the generators, fully one-half had, just previous to the starting of the elevators, been passing into the battery as a charging current, so that the actual increased load upon the generator really amounted to only about one-sixth of the extra demand. It will readily be seen from this case that when a storage battery is used in connection with a constantly fluctuating load a much smaller generating unit can be installed than would be required without its use, the decrease in size depending, of course, upon the character and extent of the fluctuations. With the case shown in Fig. 55, on account of the combined elevator and lighting service, it was found desirable to operate the generator shunt-wound upon the elevators and storage batteries in parallel and compound-wound upon the lights in a manner explained in the lecture upon switchboards.

The use of a battery in connection with a fluctuating load not only reduces the size of the generating plant, but gives to such a smaller plant an added economy due to a steady load at its full rated output. The economy to be gained by these combined advantages will, of course, vary with circumstances, but with a load in which the fluctuations bear about the same relation to the total load as do those shown in Fig. 55, the saving in fuel due to the battery auxiliary will be fully 25 per cent., making due allowance for the small loss of energy in the battery.

In determining the size of the battery for regulating purposes alone, the consideration of the actual ampere-hour or watt-hour capacity hardly enters, as it is more a question of the rate at which the battery can discharge in such service. As has already been pointed out, it is not well to discharge a battery at a much greater rate than it would be capable of maintaining for one hour, though an occasional instantaneous discharge at a greater rate may not prove injurious. It is good practice, however, in determining the size of a regulating battery to allow sufficient capacity to carry the required discharge for one hour. As the capacity of a battery at a one-hour rate is one-half the capacity of the same battery at an eight-hour rate, we have but to multiply the discharge in amperes required for regulation by two to get the capacity of the battery at the normal eight-hour rate.

[The concluding portion of Part IX. will be given next week.]

Nobel Prizes for Scientific Discoveries.

Much has been published in relation to the large bequests for prizes for scientific and literary work made by the late Alfred Nobel, the Swedish manufacturer and philanthropist. Mr. Ferguson, the United States minister at Stockholm, furnishes the State Department with the essential extract from the will, which, translated, is as follows:

My total remaining fortune, when capitalized, shall be disposed of in the following way: When the capital has been converted into good securities by the trustees, it shall form a fund, the interest of which shall be distributed annually as prizes to those persons who shall have rendered humanity the best services during the past year. The interest shall be divided into five equal portions, which shall be distributed as follows: One-fifth to the person having made the most important discovery or invention in the science of physics, one-fifth to the person who has made the most eminent discovery or improvement in chemistry, one-fifth to the one having made the most important discovery with regard to physiology or medicine, one-fifth to the person who has produced the most distinguished idealistic work of literature, and one-fifth to the person who has worked the most or best for advancing the fraternization of all nations and for abolishing or diminishing the standing armies as well as for the forming or propagation of committees of peace. The prizes for physics and chemistry shall be awarded by the Royal Swedish Academy of Science, that given to works of physiology and medicine by the Carolinska Institute at Stockholm, the prize for literature by the Royal Swedish Academy at Stockholm, and the prize given to the propagators of peace by a committee composed of five members, who shall be selected by the Norwegian Storthing. It is my absolute wish that no importance shall be attached to any difference of nationality in awarding the prizes, which, consequently, shall be given to the most competent person, whether Scandinavian or not.

The Nobel estate is so large that, if the intention of the testator is carried out, the yearly prizes will be of munificent proportions. However, it is stated that several of the heirs-at-law of Mr. Nobel are contesting the will and that it may possibly be years before the executors will be able to distribute the prizes. Minister Ferguson gives these details: "The will was dated Paris, November 27, 1895, and after disposing of about 2,000,000 kronor in legacies to relatives, servants, etc., directs that the remainder be devoted to the objects set forth in the extract which I inclose. The amount thus devoted to the advancement of science and literature is estimated to be between 30,000,000 and 35,000,000 kronor and it is thought that it will yield three per cent. per annum income, or from $240,000 to $270,000 to be annually distributed in five prizes. Each individual prize will therefore be worth between $48,000 and $55,000. Messrs. Ragnar Sohlman of Bofors, Sweden, and Rudolf Liljequist of Stockholm, Sweden, who now resides at Bengtsfors, Uddevalla, are named executors."

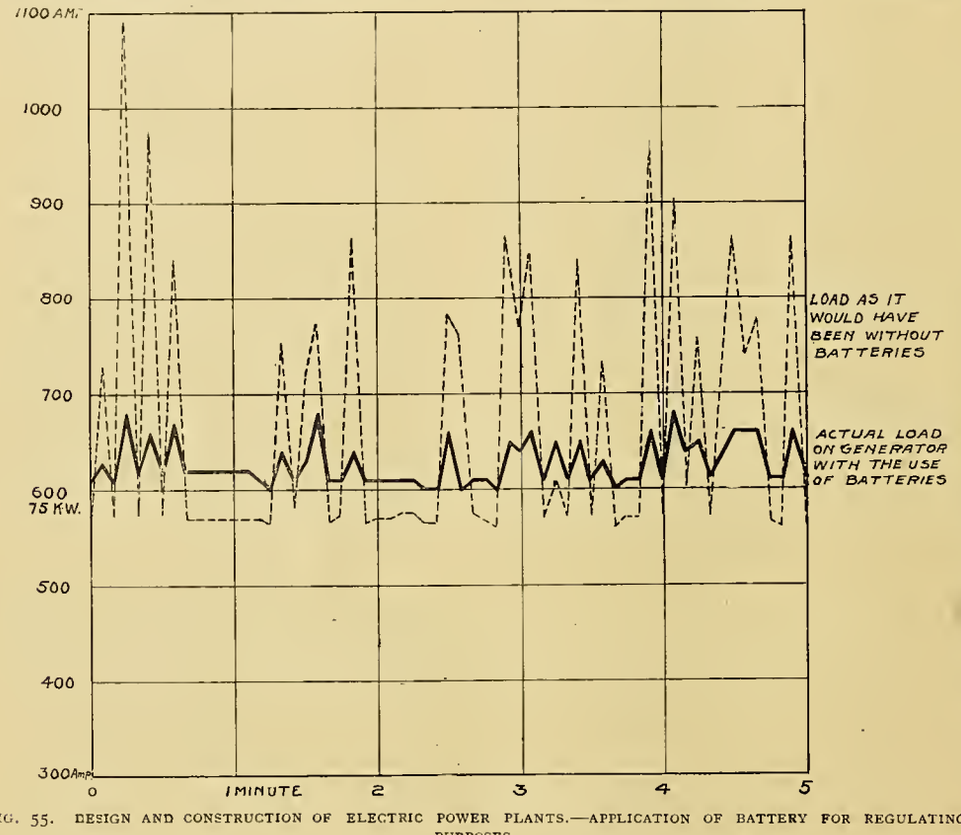


FIG. 55. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—APPLICATION OF BATTERY FOR REGULATING PURPOSES.

Mr. Preece's Views Upon Marconi's System.

On June 4th W. R. Preece read a paper before the Royal Institution at London on "Signaling Through Space Without Wires," in which he reviewed the work that had already been done in that line, and then described the Marconi system that has been the subject of so much attention.

In Mr. Preece's view Marconi utilizes electric or Hertzian waves of very high frequency. He has invented a new relay which, for sensitiveness and delicacy, exceeds all known electrical apparatus. The peculiarity of Marconi's system is that, apart from the ordinary connecting wires of the apparatus, conductors of very moderate length only are needed, and even these can be dispensed with if reflectors are used.

The transmitter is Prof. Righi's form of Hertz's radiator, and is illustrated in Fig. 1. Two speres of solid brass, four inches in diameter, *A* and *B*, are fixed in an oil-tight case *D*, of insulating material, so that a hemisphere of each is exposed, the other hemisphere being immersed in a bath of vaseline oil. Marconi uses generally waves about 120 centimeters long. Two small spheres, *a* and *b*, are fixed close to the large spheres and connected each to one end of the secondary circuit of the induction coil *C*, the primary circuit of which is excited by a battery *E*, thrown in and out of circuit by the Morse key *K*. Now, whenever the key *K* is depressed sparks pass between *1*, *2* and *3*, and since the system *A B* contains capacity and electric inertia, oscillations are set up in it of extreme rapidity. The line of propagation is *Dd*, and the frequency of oscillation is probably about 250,000,000 per second. The distance at which effects are produced with such rapid oscillations depends chiefly on the energy in the discharge that passes. A six-inch spark coil has sufficed through one, two, three, up to four miles, but for greater distances a more powerful coil have been used—one emitting sparks 20 inches long. It may also be pointed out that this distance increases with the diameter of the spheres *A* and *B*, and it is nearly doubled by making the spheres solid instead of hollow.

Marconi's relay consists of a small glass tube four centimeters long, into which two silver pole-pieces are tightly fitted, separated from each other by about half a millimeter—a thin space which is filled up by a mixture of fine nickel and silver filings, mixed with a trace of mercury. The tube is exhausted to a vacuum of four millimeters and sealed. It forms part of a circuit containing a local cell and a sensitive telegraph relay. In its normal condition the metallic powder is virtually an insulator. The particles lie in disorder. They lightly touch each other in an irregular method, but when electric waves fall upon them they are "polarized." The resistance of such a space falls from infinity to about five ohms. The electric resistance of Marconi's relay—that is, the resistance of the thin disk of loose powder—is practically infinite when it is in its normal or disordered condition. It is then, in fact, an insulator. This resistance drops sometimes to five ohms, when the absorption of the electric waves by it is intense. It therefore becomes a conductor. It may be, as suggested by Professor Lodge, that we have in the measurement of the variable resistance of this instrument a means of

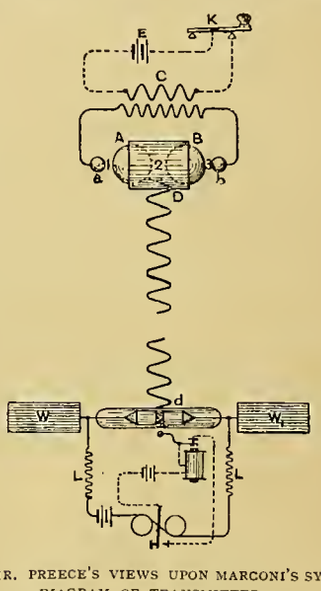


FIG. 1. MR. PREECE'S VIEWS UPON MARCONI'S SYSTEM.—DIAGRAM OF TRANSMITTER.

determining the intensity of the energy falling upon it. This variation is being investigated both as regards the magnitude of the energy and the frequency of the incident waves. E. Branly (1890) showed this effect with copper, aluminum and iron filings. Professor Oliver Lodge, who has done more than anyone else in England to illustrate and popularize the work of Hertz and his followers, has given the name "coherer" to this form of apparatus. Marconi "decoheres" by making the local current very rapidly vibrate a small hammer head against the glass tube, which it does effectually, and in doing so makes such a sound that reading Morse characters is easy. The same current that decoheres can also record Morse signals on paper by ink. The exhausted tube has two wings which, by their size, tune the receiver to the transmitter by varying the capacity of the apparatus. Choking coils prevent the energy escaping. The analogy to Professor Silvanus Thompson's wave apparatus is evident. Oscillations set up in the transmitter fall upon the receiver tuned in sympathy with it, coherence follows, currents are excited, and signals made.

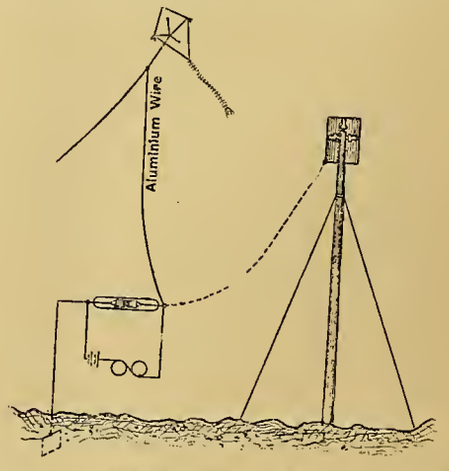


FIG. 2. MR. PREECE'S VIEWS UPON MARCONI'S SYSTEM.—CONNECTIONS FOR GROUND.

In open, clear spaces within sight of each other nothing more is wanted, but when obstacles intervene and great distances are in question, height is needed—tall masts, kites and balloons have been used. Excellent signals have been transmitted between Penarth and Brean Down, near Westonsuper-Mare, across the Bristol Channel, a distance of nearly nine miles.

Mirrors also assist and intensify the effects. They were used in the earlier experiments, but they have been laid aside for the present, for they are not only

expensive to make, but they occupy much time in manufacture.

The wings shown in Fig. 1 may be removed. One pole can be connected with earth, and the other extended up to the top of the mast, or fastened to a balloon by means of a wire. The wire and balloon or kite covered with tin foil becomes the wing. In this case one pole of the transmitter must also be connected with earth. This is shown by Fig. 2.

There are some apparent anomalies that have developed themselves during the experiments. Mr. Marconi finds that his relay acts even when it is placed in a perfectly closed metallic box. This is the fact that has given rise to the rumor that he can blow up an ironclad ship. This might be true if he could plant his properly tuned receiver in the magazine of an enemy's ship.

The distance to which signals have been sent is remarkable. On Salisbury Plain Mr. Marconi covered a distance of four miles. In the Bristol Channel this has been extended to over eight miles, and we have by no means reached the limit. It is interesting to read the surmises of others. Half a mile was the wildest dream.

It is easy to transmit many messages in any direction at the same time. It is only necessary to tune the transmitters and receivers to the same frequency or "note." Tuning is very easy. It is simply necessary to vary the capacity of the receiver, and this is done by increasing the length of the wings *W* in Fig. 2. The proper length is found experimentally close to the transmitter. It is practically impossible to do so far away.

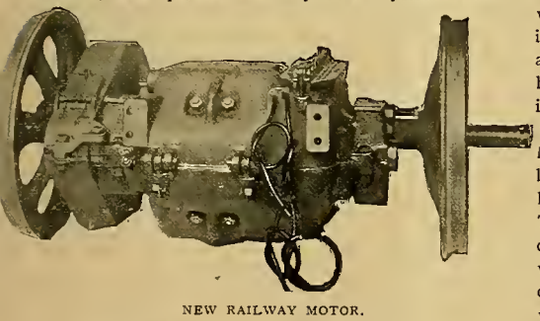
It has been said that Mr. Marconi has done nothing new. He has not discovered any new rays; his transmitter is comparatively old; his receiver is based on Branly's coherer. Columbus did not invent the egg, but he showed how to make it stand on its end, and Marconi has produced from known means a new electric eye more delicate than any known electrical instrument, and a new system of telegraphy that will reach places hitherto inaccessible.

Electric Lighting and Power Plant for the University of Michigan.

The last Legislature appropriated $20,000 for the purpose of building an electric lighting and power plant for the University of Michigan. The university already has the necessary boilers and the building. A few of the buildings are wired, and current for some of them has been obtained from the city plant, the managers of which vigorously opposed the appropriation. The entire plant, including the hospitals, includes about 4,000 lamps.

At the last meeting of the Board of Regents a contract was let to the Ridgway Dynamo & Engine company for two 75 kilowatt direct current 240 volt generators, two 120 horse power single-valve engines, and the connecting shaft, quills, etc., of the Arnold system. The capacity of the plant is the same as that of the Chicago Board of Trade. Another smaller generator remains to be contracted for.

It is proposed to use 220 volt lamps and to run motors from the same generators that are employed for lighting. These motors will replace several small engines now supplied with steam from the central boiler house. That is, the shops, the machinery in the Physical Laboratory and blowers for producing draft will all be run by means of electric motors. The exhaust steam will be used for heating purposes.



NEW RAILWAY MOTOR.

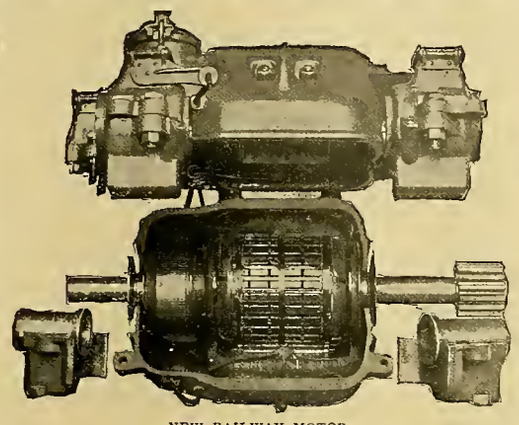
The wiring of the buildings requiring it will be done by the university under the immediate supervision of Mr. C. D. Jones, instructor of electrical engineering, and Mr. John R. Allen, instructor in mechanical engineering. Both these gentlemen have had large experience in work of this character. Engineering students will be employed to do the work. The plans on the electrical side are made by Professor Carhart and on the mechanical side by Professor Cooley. The work be will begun immediately.

New Railway Motor.

The General Electric company announces a new street railway motor, of less capacity than the G E 1,000, but of greater capacity than the familiar G E 800. As in the nomenclature of its railway motors the General Electric company has abandoned the method formerly derived from the draw-bar pull and has adopted an arbitrary nomenclature, the present motor is known as the G E 52. Its design is along lines dictated by years of experience, and no pains have been spared to make it light in weight, compact in form and simple in construction, while retaining all the excellent features of the G E 1,000 motor.

The G E 52 motor has an output of 28 horse power, rated according to a maximum rise of 75° C. in the temperature of the windings after a run of one hour at rated load, the temperature of the surrounding air not exceeding 25° C. It is intended only for ordinary street railway work and is not recommended for the heavier service to which the G E 1,000 motor is adapted, and will accommodate electric brakes; but as some additional capacity is required for brake service the company does not recommend this motor for such work except in purely street railway service.

The frame is of steel, cast in two bowl-shaped pieces and hinged and bolted in such manner that the motor is practically water and dust-proof. A hand-hole, fitted with cover-plate and gasket, is let into the lower half, directly beneath the commutator, permitting easy access to the bottom of the motor for inspection or for the removal of any foreign substance. The motor has four poles, each with its own coil. The pole-pieces are laminated and are bolted to the frame in the same manner



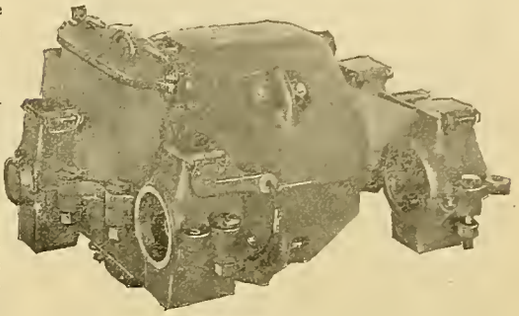
NEW RAILWAY MOTOR.

as in the G E 1,000, the bolts extending through the frame.

A large percentage of the cost of motor maintenance is due to the expense of renewing the bearing linings. The large bearing surface of this motor is one of its most important features. The armature bearings, designed for the use of oil or grease, or both, are of the following dimensions: Pinion end, 7¾ by 2¾ inches; commutator end, 6⅜ by 2½ inches; and are constructed on the "outboard" plan. The upper support for the lining is cast with the upper half of the motor frame, and when the lining is in place there is a space of one inch in the cored recess between the inner end of the lining and the motor frame. This space is occupied by a combination thrust collar and oil guard. The thrust collar is extended through the motor frame into the recess, where it acts as an oil guard. This portion of the collar is a tapered disk 6½ inches in diameter. The lower support for the lining is a cap bolted to the upper half, but not enclosing the lower half of the oil guard. This allows free outlet to the oil or grease. With this construction it is impossible for the lubricant to work into the motor. The upper grease or oil cups are of ample size and are provided with wicks or wipers, which wipe the shaft through openings cut in the linings. The axle bearings are also fitted with two wipers to each bearing.

The field coils are wound with asbestos-covered wire and "mummified." Each is held in place on its respective pole by means of the pole-piece projections, supplemented by a spring steel plate, and is placed in position before the pole-piece is bolted to the frame. For convenience in car wiring and opening for motors, the field connections between the upper and lower fields have been made on the outside of this motor, and both the field and armature leads are brought out at the front of the motor as in the G E 1,000 motor.

The armature is of the well known iron-clad hollow core type, 11 inches in diameter with a spread of nine inches. The core is built up of well annealed laminæ, and, to increase the circulation of the air, is provided with three ventilating ducts, as in the G E generator armatures. The armature has no spider, but it is assembled directly on the shaft. There are 29 slots in its periphery, each slot containing three coils formed into a compact unit; consequently there are 29 sets of coils and 87 commutator bars. The small number of coils is of special advantage in the matter of armature repairs, while



NEW RAILWAY MOTOR.

the method of forming them in groups of three admits of a substantial insulation of high quality. The comparatively small weight of the armature and its consequent small inertia will be readily appreciated.

The standard gear ratio is 4.73, with taper bore pinion having 14 teeth and a cast-steel gear having 67 teeth. Higher speed gear ratios may be used, furnishing increased speed with proportionately decreased tractive effort.

The commutator segments are of hard drawn copper $1\frac{3}{16}$ inches deep, allowing a wearing depth of one inch. In assembling clamping belts have been dispensed with and the clamping ring is held in place by a ring nut.

The brush-holders are standard, and staggered to prevent the wearing of ridges in the center of the commutator. Each holder contains two radial brushes 2¼ inches long, 1¼ inches wide and one-half inch thick. The brush-holder yoke is carefully treated with an insulating compound and rubbed to an enamel finish, preventing the lodging of carbon dust.

The suspension can be either the nose, the yoke or the sidebar, as with the G E 1,000 motor. The yoke suspension is especially recommended, as with this suspension the weight of the motor is carried on springs, placed upon the side frames of the car trucks. Lugs are cast on the upper half of the motor frame, to which the suspension bar is bolted, the motor being suspended from the top half. This permits easy access for inspection or repairs, as the lower half can be swung down into the pit without disturbing the upper half, which remains suspended from the axle and suspension yoke. The same adjustable axle collar is furnished as with the G E 1,000 motor.

When the motor is mounted on 33 inch wheels, the clearance between the bottom of the motor and the top of the track rails is 5⅞ inches. The clearance between the bottom of the gear case and the top of the track rail is 4⅝ inches—a feature which railway men will appreciate.

The motor, without gear or gear case, weighs 1,450 pounds; complete, with 67 tooth gear and malleable iron gear case, the weight is 1,725 pounds.

Insects Attracted to the Naturalist's Net by Electric Light.

By reason of its brilliancy the electric light is occasionally used as a lure to trap fishes or insects at night. A French entomologist describes a plan to secure specimens of the creatures that are so numerous and noisy about stagnant ponds on a summer evening:

Take an incandescent lamp of three or four candle power and place on the bank of the pond a small storage battery like those used for electric bicycle lamps. Connect it to the lamp by wires of sufficient length. The lamp, which is too light to sink into the water, is fixed to a semicircle of iron, and below the semicircle and lamp is placed a large net having an opening 80 centimeters [32 inches] across, and similar to those used for snaring birds. The net is made of coarse packthread and provided with a string. The whole, lamp and all, is lowered very slowly into the pond. The lamp is lighted; insects, fish, lizards, frogs, tadpoles, larvæ of every kind rush up to it in great numbers. The string is now pulled, closing up the net, and by a single movement several pounds of victims are captured, especially if there are fish in the pond. A small Geissler tube excited by an induction coil can be used in the same manner.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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HIGH WATER MARK

CIRCULATION, 20,000.

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WITH the Niagara Falls convention number of the WESTERN ELECTRICIAN, dated June 12, 1897, this journal made a new record for itself both in circulation and advertising. Of this 100-page number 20,000 copies were printed and circulated and the amount of full paid advertising matter carried was 8,643 square inches.

The remarkable success of this journal, especially in view of the hard times that have prevailed throughout the country, is all the more striking because of the fact that it is only 10 years since the first number was issued. Its advancement has been rapid and in keeping with the progress of the great industry it represents and the splendid field which it occupies. It is a noteworthy fact, especially in view of existing conditions, that during the period of depression this journal has made steady gains in advertising. Beginning with the convention number of March 3, 1894, the record shows constant gains each year until in the present case the number of square inches of full paid advertising matter is more than double that of the 1894 number. The figures showing this unprecedented gain are given in the accompanying table:

Issue.	Number of Advertising Pages.	Whole Number of Pages.	Square Inches of Paid Advertising Matter.
March 3, 1894	40	56	4,145
February 23, 1895	52	68	5,593
May 9, 1896	72	88	7,576
June 12, 1897	80	100	8,643

This constantly increasing patronage speaks eloquently of the influence and merit of this journal and of the confidence and respect which it commands throughout the country. It is pleasing recognition of the efforts that have been made in the interest of the entire fraternity.

IT is of much scientific interest and of not a little practical importance to determine the conditions resulting in the maximum attractive power of the electromagnet. From a note extracted from the "Proceedings" of the Royal Society of London, we learn that "H. Wilde has exceeded his own estimated limit of 400 pounds per square inch for magnetic traction by means of annealed charcoal-iron wire 0.57 inch in diameter. The electromagnet was excited by a current of 40 amperes. With a piece of wire 1.2 inches long the unprecedented tractive force of 422 pounds per square inch was obtained. That the magnetization limit was virtually arrived at was shown from the fact that, when the current transmitted round the electro-magnet was reduced from 40 to 26 amperes, the amount of the tractive force remained constant. The determinations were made with a single-pole electro-magnet." These detail are meager, but the result obtained is certainly extraordinary.

WITH the single exception of Prof. William Crookes no person who has won distinction in pure science was rewarded with knighthood at the jubilee of Queen Victoria. Under the circumstances the selection of Prof. Crookes is especially pleasing to his friends, and it is conceded that the distinction could not have been bestowed upon a worthier subject. Prof. Crookes has won distinction by his labors in the electrical field, his invention of the Crookes tube bringing him into special prominence of late through the close relationship between his work and the discovery of Baron Röntgen. The selection will therefore be commended throughout the scientific world.

But it is really singular that at this time, when an apparent effort is being made to convey the impression that the queen and her ministers appreciate the luster that has been shed upon the reign of Victoria by the progress that has been made in the realm of science and letters, decorations were bestowed so profusely upon those who have served the government in civic, naval and military capacities, and those who are supposed to be in position to advance political missions, while the scientists were neglected in comparison. It does not appear that the distinction so palpably made is an enviable one.

THE idea of arming a corps of electrical engineers for militia service, as is to be done in England, has an element of the ridiculous in it that is appreciated by some of the English themselves. The *Electrical Review* of London—which, by the way, seems to have the right to style itself "the oldest weekly electrical paper," on the showing of Mr. Lockwood of Boston and Mr. Fitz-Gerald of London—fears that the corps will be top-heavy with officers, from the class of men composing it. "We doubt not that officers will be readily found," says our contemporary, "but most of them will feel somewhat reduced in the profession if their drill is to consist of switching on and off a few searchlights, or laying short lengths of torpedo cable. What arms are the new volunteers to carry and are the officers to be mounted? Suggestions are made to us that the staff should ride on electric motor cars, and the rank and file should each carry a wireman's complete outfit, with a few extra sticks of 'Chatterton,' three spanners and a coil of wire—though none of these are of much service for personal defense in hand-to-hand fighting. For that we should recommend a three-foot length of lead-covered armored 61-12 cable, used in the style of a mediæval mace." The whole idea is so incongruous that it is small wonder that it is the butt of ridicule. It is very patriotic and proper, no doubt, for the electricians to serve as volunteers, but why have a distinct "corps" of them any more than of architects or surgeons or carpenters?

IN both New York and Chicago the projects for electric railways operated by the medium of underground trolley wires are meeting with much opposition. In the former city a rival company attacked the plan, and has received the practical co-operation of a number of property owners and of those who desire to see the municipal government attempt to secure the lines in question, now operated by animal power, under the terms of an old charter. There also appears to be some conflict of authority between the city Department of Public Works and the Board of Electrical Control in the matter of granting the desired permission, and, all told, the proposal is so bound up in red tape, which can only be untied by tedious legislation, that the prospect of the actual operation of the trolley conduit system is dubious.

In Chicago the situation is different, and the outlook for a trial of the underground plan is still more hopeless. An application was made for a franchise for a new street railway system on the South Side in which buried trolley wires were to be used. The City Council passed the ordinance, but the project was not put into execution. There were rumors of consolidation with this or that existing road, of the great designs of outside capitalists, and other startling reports, but no actual work was done. Then, on July 6th, the council veered directly around and suspended its rules by a two-thirds vote to pass at once a new ordinance giving the General Electric Railway company, which was to have built the trolley conduit road, the right to use the overhead trolley system. The new ordinance is likely to be vetoed by the mayor, but what is known as the "boodle element" in the council has enough votes to pass it over the veto. The ordinance allowing the General Electric Railway company to change its motive power to the overhead trolley system was accompanied by a petition in which it was stated that the underground system at first contemplated had been found to be impracticable, and that it was deemed necessary to adopt the overhead wires to sell the bonds the road desired to put on the market. One of the many conjectures brought out by this surprising action is that the franchise has been sold and that the change was necessary to bind the bargain. At any rate, it appears that, for the present at least, there is no prospect of an electric railway in Chicago to be operated from trolley wires laid underground. From a comparative engineering point of view this is to be regretted, as with cable, overhead trolley and storage battery roads in operation, the buried trolley system would about complete the practical possibilities in street railway work, and all might be compared on their merits under similar conditions.

Another interesting development of the street railway situation in Chicago is the likelihood that the main north-and-south trunk lines of the Chicago City Railway company on State street and Cottage Grove avenue, now operated by cable, may be transformed into overhead trolley roads. The WESTERN ELECTRICIAN intimated last week that this change was impending. The improvement has been seen to be inevitable for some time, but it now appears that it may come quicker than had been anticipated. The company is now figuring on the change, and the cost is estimated to be about $1,200,000. This is a large sum of money to invest in new equipment, and of course it could not be contemplated were it not for the ultimate saving to be effected. The improved service is also taken into consideration both by the company and by patrons. The excellent operation of the company's long electric lines—their comfort and speed—has been an unfailing object lesson to those South Siders who were loud in denouncing the electric cars three or four years ago. We don't hear as much about the "deadly trolley" as we did. Things are different than they were. Two delegations of business men in State street south of Thirty-ninth called at the office of the railway company last week and urged that the cable cars give way to the trolley. Traffic on the State street cars has decreased considerably since the Wentworth avenue electric cars began to run, and the Cottage Grove avenue cables have also felt the effect of the competition of the faster system. If the directors give formal approval to the change and if the city authorities give the necessary permission, it is probable that the work will be started at once. Mr. Bowen, the general manager, estimates that it could be carried out in four months, and during that time the cable cars would run as usual. It is thought that the electric cars might be in operation by the beginning of 1898. The existing cable power stations will be made over into electric power houses, if the plan is adopted, and the cable conduits will carry the feeder wires. Cars that are heavy enough will be fitted with motors and trolley poles, while the lighter ones will be used as trailers. The track is already in fair shape to serve as the return circuit. When the change is accomplished it will mark a notable victory for the use of electrically transmitted power in street railway work.

The Spectrophotometry of Incandescent Lamps.

By W. R. Turnbull.

In the January 1st (1896) number of the *Electrical Engineer* of New York, Dr. W. H. Birchmore published an article on "The Mistaken Ideal of Artificial Light Improvers." His curves are plotted from, and his paper is based on, a table of mistakes which unfortunately appears in Palaz's excellent book on "Industrial Photometry." This table purports to come from O. E. Meyer, but the *Beiblaetter* reference[1] to Meyer's article gives tables which are, in main essentials, the same as the tables of other investigators. Apparently, Palaz, in copying Meyer's table, did not give sufficient attention to having the ratios right, and therefore the table gives, for the most part, the reciprocals of the proper values; *e. g.*, Palaz gives

$$\frac{\text{sunlight}}{\text{gaslight}} = 4.07$$

at the "B" line, whereas Meyer gives

$$\frac{\text{gaslight}}{\text{sunlight}} = 4.07.$$

The result is that the entire table is a mistake, through which he attributes a large amount of blue rays to incandescent lamps, and it is surprising that Dr.

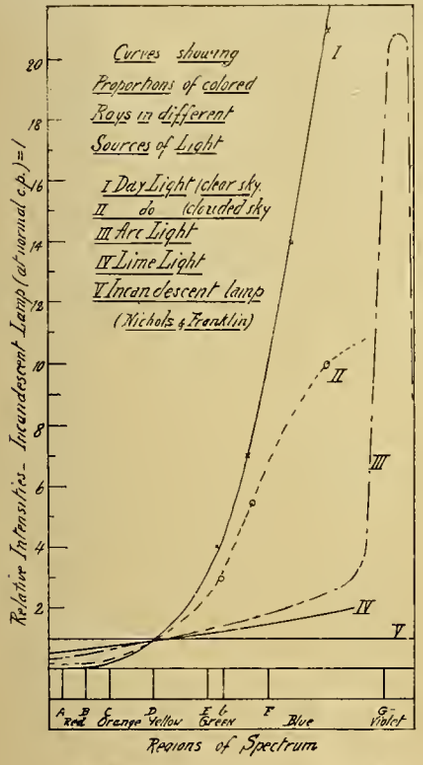


FIG. 1. THE SPECTROPHOTOMETRY OF INCANDESCENT LAMPS.

Birchmore did not compare such startling results with the work of others, for to a worker along these lines the error is apparent.

In aiming to improve our light sources, we should indeed take sunshine as the ideal and normal light, but the combined work of Schumann, Meyer, Vierordt, Nichols, Franklin and others shows that our artificial sources are weak, not strong, in violet rays, and they are strong, not weak, in red rays; there is, therefore, no mistaken ideal in attempting to get higher percentages of blue rays in our artificial lights, for we need them.

Had this mistaken table been quoted by one writer alone, it would hardly have been necessary to call attention to it; but again, and more recently,[2] it has been made use of by Mr. M. A. Edson in an article on "Vacuum Tube Lighting." In the context of this table (which is transformed into percentages) he says: "As is well known, violet light should be avoided." How has this become "well known," when it is in direct variance with the results of all workers who have studied the matter thoroughly? It is true that a violet light is to be avoided, just as a red light or a green light is to be avoided, but a light with its proper proportions of violet light, as determined by our natural illuminant, the sun, is to be desired and not avoided. The light from vacuum tubes often has a preponderance of violet and ultra-violet rays, but this is not always the case, for a tube containing traces of hydrogen gives a bright red light, one containing nitrogen a purple light, and so on.

1. *Beibl. zu Wied. Ann.*, 1880, p. 130.
2. Western Electrician, March 6, 1897.

It is probable that if vacuum tubes were filled with proper proportions of several different gases, before exhaustion, that the remaining traces of the gases would give to the light the proper proportions of all rays from red to violet.

I am sorry to have to speak so critically of the two articles above cited, but it is time that our inventors

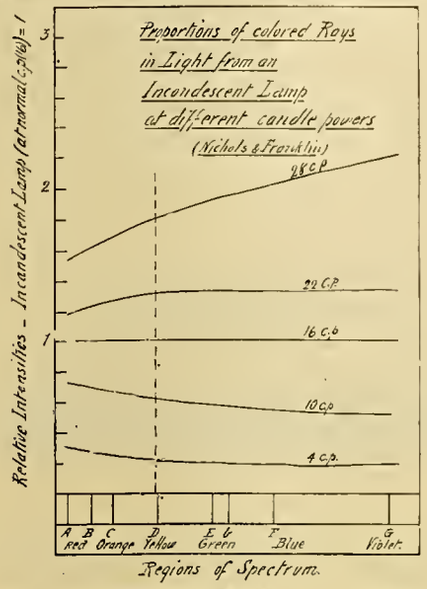


FIG. 2. THE SPECTROPHOTOMETRY OF INCANDESCENT LAMPS.

and engineers were helped by the investigations of physicists who have studied the subject, and not misled and confused by articles which, were the tables on which they are based corrected, would disprove just what the writers attempt to prove.

The accompanying curves give the results obtained by Nichols and Franklin[1] and by Schumann[2] in extended studies of the incandescent lamp. Their results are in good accord with those of other investigators and may be considered typical.

Fig. 1 shows the proportion of colored rays in different sources of light; the light from a 16 candle power Edison lamp (operating at normal candle power) being taken as a standard of comparison and all of the sources being made equal to unity in the yellow region of the spectrum (at the *D* line). It is obviously necessary to reduce the intensity of the light from different sources to unity at some point (*e. g.*, the *D* line), since we are only concerned with proportions of colors and could make no measurements that would mean anything by comparing the total brightness from sources such as the sun and any artificial light. No. I. is the curve for daylight when the sky is clear, and it shows in a most marked manner how very intense the blue end of the spectrum is in comparison with the incandescent lamp (V.) and with other artificial sources, such as the arc light (III.) and lime light (IV.), although in the case of the arc light there is one region, in the violet, where the radiation

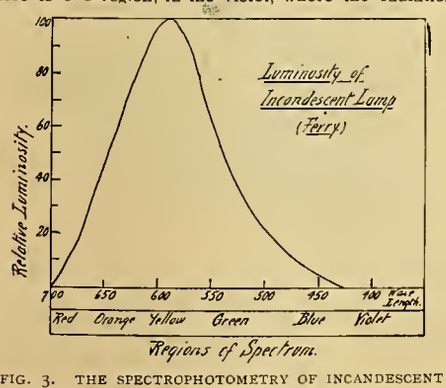


FIG. 3. THE SPECTROPHOTOMETRY OF INCANDESCENT LAMPS.

is unusually intense. Curve II. shows that with a clouded sky daylight is not so predominatingly strong in blue rays, although it still shows itself much stronger than most artificial sources. Were curves for petroleum and gas plotted on Fig. 1 they would be a little above curve V. at the red end of the spectrum and somewhat below it at the violet end.

Fig. 2 shows curves for a 16 candle power Edison lamp operated at the abnormally high candle powers of 22 and 28, and at the abnormally low candle powers of 10 and four. It will be noted that at the red end of the spectrum the intensity increases more slowly than candle power, and at the violet end the intensity increases more rapidly than candle power. There is an intermediate region in which the intensity is proportional to candle power, and the dotted line in the figure shows at what position this holds true; it is in the yellow, very near the *D* line.

It is to be hoped that in considering Fig. 1 no confusion with luminosity will arise. The curves of Fig. 1 simply give comparative values for the intensities of different sources in different regions of the spectrum, when these sources are compared with a 16 candle power lamp and when the intensities at the *D* line have previously been made equal; *e. g.*, curve I. shows that sunlight, in the blue region, is proportionately 20 times brighter than the light from the incandescent lamp in the same region, and so on; but it tells nothing of the luminosity of a single source for any region of the spectrum and it gives no comparisons of luminosities for different sources.

Information of this kind can only be obtained from such a curve as that shown in Fig. 3, which is the luminosity curve of an incandescent lamp at normal activity. This curve shows to what extent the different colored rays, making up its light, contribute to the light-giving power of the source.

Luminosity curves may be plotted in several ways,

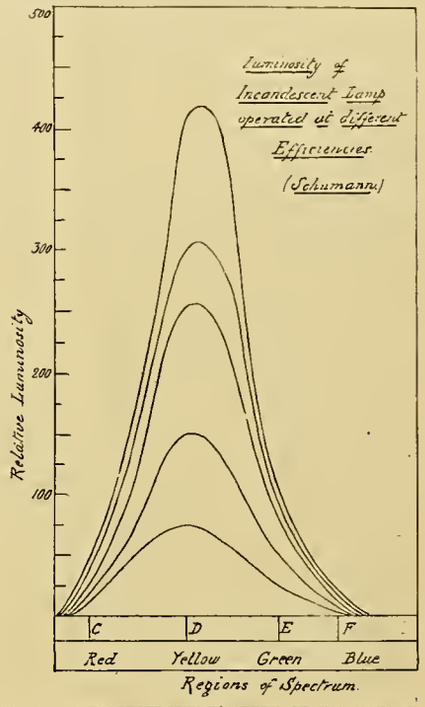


FIG. 4. THE SPECTROPHOTOMETRY OF INCANDESCENT LAMPS.

but the most usual one is to hold a book (one that necessitates reading, not inference, such as a table of logarithms) in the different parts of the spectrum and regulate the intensity of the light until one is just able to read the print at a fixed distance. Holding the book first in the red, then in the orange, and so on, the light will, in general, be decreased until the yellow is passed, when it will have to be increased as we approach and enter the green, blue and violet. The inverse of the values thus obtained for intensity of the source, when different parts of the spectrum are considered, are then plotted as ordinates (the maximum luminosity being called equal to 100) and the regions of the spectrum are made the abscissæ.

This curve of Fig. 3 is similar in form to curves for most other sources of light having a complete spectrum, but it is, of course, not identical with these, and for the incandescent lamp itself the luminosity curve changes in magnitude and form as the watts per candle change. (See Fig. 4, from Otto Schumann's results.)[1] The lowest of these curves is that for a lamp operated at a low efficiency, and the highest of them is for the same lamp at a much higher efficiency. Luminosity curves of all sources that emit a complete spectrum from red to violet must be similar in general form, from the very nature of our organ of vision, with its limitations beyond both ends of the visible spectrum.

An examination of these curves shows that one ought

1. *Proceedings* of the American Association for the Advancement of Science, August, 1888.
2. *Elektrotechnische Zeitschrift*, May, 1884.

1. See E. L. Nichols' paper, *Proceedings* of the American Institute of Electrical Engineers, May, 1889.

to manufacture yellow light in order to obtain maximum efficiency, for yellow light gives a maximum return for the energy expended, but at the same time it is obviously necessary, for the health of our eyes, to have a light with the proper proportions of all rays in it, and no one, for instance, would advocate the use of the sodium light by which to read.

"The most important wave lengths, so far as light-giving power is concerned, are those which form the yellow of the spectrum, and the relative luminosity falls off rapidly both towards the red and the violet. The longer waves have, however, much more influence upon the candle power than the more refrangible rays, as will be seen by an inspection of the curves [Fig. 4], the relative falling off of the red end of the spectrum being compensated by larger and larger accessions in the blue and violet as the state of incandescence increases.

"Luminosity is the factor which we must take into account in seeking a complete expression for the efficiency of any source of illumination, and the method to be pursued in the determination of luminosity must depend upon the use to which the light is applied. If we estimate light by its power of bringing out the colors of natural objects, the value which we place upon the blue and violet rays must be very different from that which would be ascribed to them if we consider merely its power of illumination as applied to black and white. In a picture gallery, for instance, or upon the stage, the value of an illuminant increases with the temperature of the incandescent material out of all proportion to the candle power, whereas candle power affords an excellent measure of the light to be used in a reading-room."[1]

It is not my object to go further into this subject at present; this paper simply strives to correct a mistake which already has become far too widespread, and if it serves to make matters at all clearer regarding both the composition of the light from different sources and the meaning of the term "luminosity," it will have served its end.

Acetylene Searchlights Proposed for Niagara Falls.

A proposition has been made by the Acetylene Light, Heat & Power company of Niagara Falls, through its manager, Joseph Devine, to light the American Falls by a series of searchlights erected, as now proposed, on Goat and Luna islands. In all about a dozen lamps are to be placed, and these are to be operated by acetylene gas. The reason given is a desire to make a public exhibition of the illuminating powers of acetylene gas. Calcium carbide, from which the gas is made, is manufactured in large quantities at the Falls, and it would seem quite appropriate that the first public exhibition of the powers of the gas should be made there. The falls under artificial light at night present a magnificent spectacle, and all who saw the illumination by electricity some years ago remember it as one of the grandest evening sights in memory. At the time the state of New York took the lands about the falls for park purposes in 1885, the electric light plant in Prospect Park was discontinued and the illumination of the falls and the beautiful fountain in the park was also discontinued. It is only within a year or two that public sentiment forced the park commissioners to establish electric lights about the domain under their charge, but none of these lights are used for showing the beauties of the rapids and falls. With the acetylene gas the light may stream across the upper rapids and the falls, adding much to the pleasure of an evening at Niagara.

American Representation at the Munich Exposition.

An international exposition of engines, motors, machinery and tools will be opened at Munich on June 10, 1898, and will continue four months. An effort is being made by Alfred Weller and C. E. Freeman of Chicago to secure a representative American exhibit. It is pointed out that a more favorable occasion for the American manufacturer could not have been selected. In Europe, and in Germany particularly, manufacturing interests in general are thriving. The result of this condition is shown in the custom-house statistics. The gentlemen in charge of the affair hope to enlist the support of manufacturers of electrical machinery, especially small motors for shop work.

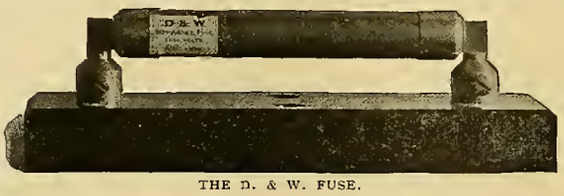
1. E. L. Nichols.

The D. & W. Fuse.

An exhibit that aroused considerable interest at the recent convention at Niagara was a non-arcing fuse manufactured by the D. & W. Fuse company of Providence, R. I. This device, shown by the cut, is quite a departure from the heretofore prescribed methods of fuse design and possesses several improvements. The manufacturer's statement is quoted:

"The D. & W. fuse is absolutely non-arcing under any conditions of rupture or short-circuit or overload, and shows a high degree of accuracy as regards blowing time for any given current value. It has been exhaustively tested under the most severe condition by the underwriters, who give it the highest indorsement.

"The principle involved is that of enclosing the fuse within a tube which is then filled with a certain granulated material except at the center, where an air space of definite dimensions is provided. In this way the melting time for any given current value is made constant, since there can be no variation in the air space or the amount of material in contact with the fuse metal, and on short-circuit paths are provided between the granula filling for the escape of the vapor, which prevents arcing.



THE D. & W. FUSE.

"These fuses are intended especially for high-tension work from 500 volts direct to 1,000 and 2,000 volts alternating, and the company is turning out a complete line of motor and feeder cut-outs, transformer boxes and a junction fuse and switch box, also a line of subway boxes. In this direction it has been especially successful, since this fuse is the only one that can, with any safety, be enclosed within a water and air-tight box and yet operate with perfect security to the fittings. All these devices are fully illustrated in a catalogue recently issued."

The inventors of the fuse, L. W. Downes and William C. Woodward, are both central station men who have had long experience in the manipulation of high-tension systems, and the experience gained in this way has enabled them to produce a device which is claimed to be commercially practical in every sense. The illustration shows one of the feeder and motor type of cut-out with its mounting.

Cardew Earthing Device.

The illustration shows the Cardew earthing device for protecting transformers. This appliance is manufactured under English license by the Diamond Electric company of Peoria. It has proven very successful in England, over 5,000 being in use. The action depends on electrostatic attraction between two plates of an aluminous foil; the lower is permanently kept at the potential of the earth, while the upper plate under ordinary circumstances possesses a potential not exceeding the secondary voltage. The electrostatic attraction corresponding to this potential difference is insufficient to raise the foil. If, however, a fault occurs between the primary and secondary, the potential difference immediately rises to such an amount that the electrostatic attraction suffices to raise the foil and bring it into contact with the upper plate, thereby earthing the secondary winding and making the primary fuse blow. The apparatus is set to come into action if the potential of the secondary rises to 400 volts. Hence, even an incipient fault in insulation between the two circuits is sufficient to automatically disconnect the transformer from the circuit.

CARDEW EARTHING DEVICE.

Standard Candle Power of Incandescent Lamps.[1]

By Dr. Louis Bell, James I. Ayer and L. A. Ferguson.

The task that your committee undertook was to draw up a suitable specification for a standard incandescent lamp and to devise a proper method for the commercial application of this standard.

This problem divides itself into the three following heads:

I. The determination of a standard of light and the method of applying it under commercial conditions.

II. The specification of a direct, simple and rapid method by which the members of this association and other users of incandescent lamps can apply such a standard of light to the testing of commercial incandescent lamps.

III. The specification of a normal standard of luminosity to which commercial incandescent lamps shall adhere.

The first task was the selection of a primary standard of light to serve as the basis of operations, proper apparatus and methods for its utilization for the purpose in hand. There are in use as primary standards of light a considerable variety of sources of light, to-wit: Two standard candles, English and German; three standard lamps burning definite substances under definite conditions—the Carcel lamp, the Harcourt pentane lamp and the Hefner-Alteneck amyl-acetate lamp; one standard gas light—the Methuen—and finally the Vinlle platinum standard, one square centimeter of platinum at its point of solidification. In addition, there are more or less desirable forms of photometer.

Even assuming a standard light and method, the comparison of an incandescent lamp with it may be under all sorts of conditions and at all sorts of angles.

In this state of affairs your committee requested the co-operation of the American Institute of Electrical Engineers, and through the courtesy of the council of that body the problem was referred to the committee on units and standards. The following determinations were presented by that body, in which your committee, having discussed the matter in joint conference, concurs:

(A) The Hefner-Alteneck amyl-acetate lamp is recommended as the primary standard, it being, on the whole, the most reliable and uniform. It possesses the additional advantages of having been subjected to most exhaustive tests to determine its behavior under different conditions, and of being readily obtainable in standard form from an authoritative source.

(B) The Lummer-Brodhem photometer screen is recommended as being well suited, from its great sensitiveness, to exact and refined determinations.

(C) It is recommended that in testing incandescent lamps by these means the lamps be revolved on a central axis at the rate of about two revolutions per second. This process gives the mean luminosity in the plane of revolution without a multiplicity of measurements.

(D) It is recommended that, in so far as the conditions of commercial testing allow, the normal standard incandescent lamp be rated in terms of its mean spherical candle power.

It now became the task of your committee to put these recommendations in such concrete form as would most directly render them useful to the members of this association and others interested in the everyday work of testing lamps.

For easy and accurate photometric work it is highly desirable that the lights compared should be of nearly equal color and intensity. The Hefner-Alteneck standard is of about one candle power, and has a slight orange cast, so that while giving very precise results in careful hands, it is somewhat inconvenient for rapid comparisons. Your committee therefore recommends the use of the Hefner-Alteneck standard to prepare secondary standards for commercial use. These standards should be incandescent lamps of uniform shape, construction and character, standardized with the greatest attainable exactness and suitable for direct comparison with commercial lamps. In testing lamps by these secondary standards, the above-mentioned photometer screen being rather difficult of manipulation for rapid work, we recommend a form of photometer designed specifically for use in connection with a standard method of measurement hereinafter described.

To avoid the complication incident to spinning both the secondary standard and the lamp being tested, we advise placing on the socket of the secondary standard a defining mark showing the direction in which the directly given light is exactly equal to the mean determined by spinning. By placing this mark toward the photometer screen and in the plane of the photometer bar, only the lamp under test need be spun.

It is obvious to your committee that the common rating of incandescent lamps by their mean horizontal candle power is objectionable and should not be continued. In the first place, as incandescent lamps and other lights are practically placed, the spectator is invariably below them, and hence, if their axes are vertical, below the principal plane of illumination. If their axes are tilted we still get the full advantage of but a portion of this principal plane. Second, it is unfortunately only too easy to produce lamps in which the maximum light is not only in the horizontal plane, but which in all other directions give decidedly poor illumination. Such lamps are practically of far less than their rated candle power.

The ideal distribution of light would be a uniform spherical one, except in so far as the socket might pre-

1. Report of committee of the National Electric Light association, presented at Niagara Falls, N. Y., June 10, 1897.

vent. In any ordinary position such a lamp would distribute at least half its light uniformly downward where it would be of most use. In practice this cannot be readily obtained, but it is easy to produce a lamp that will give a fairly uniform distribution, at least below the plane of the socket when the socket is uppermost.

Rating lamps by mean spherical candle power will strongly tend to produce lamps having such a distribution. The measurement of mean spherical candle power is, however, a very troublesome matter, and, even under the most favorable circumstances, is a slow process, not readily applied to commercial testing.

Your committee, therefore, cast about for a practical method of testing, such as would insure a good and useful distribution of light and would be easy to apply. In other words, How shall the light of a lamp be measured so as to rate it as nearly as practicable on its useful distribution of light?

After looking into the distribution of light actually given by commercial lamps, your committee believes that the light given half way between the vertical and horizontal planes forms the best simple criterion available. This can readily be measured by rotating the lamp socket down, with its axis inclined 45 degrees toward the photometer screen and in the plane of the photometer bar. This measurement gives a fair mean between the horizontal and vertical illumination, and in most commercial lamps is a tolerable approximation to the mean spherical candle power. Furthermore, it insures a good downward distribution of light, even in a lamp designed to meet this particular method of measurement.

Your committee is fully aware that no simple measurement can truly calculate the effective luminosity of all forms of lamp, but, recognizing that in the rapid commercial testing of lamps a single simple measurement is highly important, strongly recommends this one as most nearly meeting the necessary conditions.

By this process of simplification we have reduced the measurement to be made by the user of incandescent lamps to the comparison of two nearly equal and similar lamps, of which only the lamp under test has to be revolved.

Furthermore, in much commercial testing it is not necessary accurately to determine the candle power of the lamp under test. In most cases it is sufficient to determine that it falls within certain definite limits prescribed for the normal standard lamp. Hence it will generally not be necessary to make an exact setting of the photometer screen, but merely to observe the conditions existing when the screen is resting against stops in two fixed positions, one corresponding to the minimum permissible candle power of the lamp under test, the other to the maximum. The actual process of testing would then be as follows:

Having placed the standard lamp in its marked position, and adjusted the voltage to its normal value, the observer would then place the lamp to be tested in its socket and spin it, having first pushed the photometer screen against the stop. If the candle power was all right on this test, he would pull the screen against the other stop and look again. The whole process need not take over 15 to 30 seconds, according to the skill of the operator, and would show definitely whether or no the lamp fell within the standard limits. Your committee will in due season place in the hands of the secretary a full specification for the making and use of a simple photometer, designed to be used in the manner just indicated.

We now reach the third portion of our task—the definition of a normal standard to which commercial incandescent lamps should conform. At present there is much confusion on this matter, and we feel that it must be reduced to terms at least simple and definite.

It seems to your committee inadvisable at present to complicate the situation by introducing considerations of efficiency, life and variations of candle power with life. Efficiency, the candle power being known, is settled at once by the application of a voltmeter and ammeter, and the matter of life may properly be left to the natural course of competition to settle. Variation of luminosity with time is a matter of importance, and, after a general and uniform standard has been promulgated, may properly be considered. For the present, however, your committee is of the opinion that attention should be confined to the adoption of a standard specification for light alone, and the production of suitable apparatus for testing the fulfillment of this specification. To this end we believe it best to rate commercial incandescent lamps by the illumination obtained when the lamp is spun with its tip inclined 45 degrees from the vertical toward the line of observation, and to specify the rating in candle power, this being the most familiar measure of light and definitely legalized in some states. The ratio between the English standard candle and the Hefner-Alteneck lamp has been accurately determined by several experimenters, so that it is easy to pass from the latter to the former, thus avoiding the extreme unsteadiness when used directly.

As a matter of manufacture it is very difficult to produce a lamp of a given voltage for an exact specified candle power. Hence certain limits must be set, rather than a certain definite candle power, and these limits should be so drawn as to meet both the conditions of manufacture and to insure a reasonably close accordance with the rated intensity. For an incandescent lamp rated at 16 candle power (oblique zonal as above indicated) 15 candle power for the minimum and 17 candle power for the maximum afford limits fair to all parties concerned, and these your committee recommends.

As to the method of procuring and distributing the secondary standards to be used with the photometric method already outlined, the following is desirable: Incandescent lamps of uniform shapes and in standard sockets, with filaments uniform in shape and section, in all respects unmarked, should be furnished by the lamp manufacturers to the standardizing committee. These lamps should then be properly aged and standardized at such voltage as may give precisely 16 candle power with the greatest attainable precision, marked on the sockets with a reference line, numbered, certified and dated. They should then be turned over to the secretary for distribution at a price covering the cost of standardizing and handling.

Your committee therefore recommends:

1. That the standard 16 candle power incandescent lamp shall be a lamp which, when measured in rotation at about the rate of 180 revolutions per minute, with its axis inclined 45 degrees, as herein specified, shall give not less than 14½ and not more than 17½ candle power and that every 10 lamps shall average between 15 and 17 candle power.

2. That your committee shall be empowered to make suitable provision, with the consent of the executive committee, for the production of the secondary standards and to request the co-operation of the American Institute of Electrical Engineers in the formation of a non-partisan committee to supervise and certify said lamps.

3. That the secretary be directed to undertake, under the direction of your committee, the procuring of lamps for standardization, their distribution when standardized, and the preparation and distribution of the specifications of your committee for a standard form of photometer and a standard method of employing it.

DISCUSSION.

MR. AYER: I will state in connection with this report that the theory is to have a form of incandescent lamp specified which may be produced by the different manufacturers, so made that it could be without identification marks, and submitted and sent to the secretary, these in bulk to be turned over to some college testing laboratory, where the testing process should be under the supervision of this non-partisan committee of the association and of the American Institute of Electrical Engineers. The members of the Institute were loth to mix up with any commercial transaction of this kind, but seeing the importance of securing some standard, and knowing of the plan that was offered, whereby they could co-operate, they have admitted their willingness to take part in it in this manner. As to the efficiency of the photometer and the arrangement of it, it is proposed to make a specification of a photometer, which would cost little, to be handed over to different manufacturers, and when made the instrument would be submitted to this committee for its approval as to mechanical excellence and suitability. This puts the central station man in a position to have a photometer which can be easily operated by any ordinarily intelligent station employe, easily determining the initial candle power of the lamps compared; and later on, if he care to get life test and other data it makes it extremely simple. Half a dozen lamps of as many manufacturers, or a number of manufacturers, could be placed on the rack in the station subject to these working conditions, at intervals of time after the first test, starting at the same initial candle power within the limits mentioned, and could be compared for life and quality as to the time limit. That is, you can get down ultimately and put the central station man in the position of being able to know what the candle power value of his lamps is.

MR. STETSON: I did not understand whether the base of the lamp, at 45 degrees, was the orifice or the dome.

MR. AYER: The dome would be inclined toward the screen, but the center of the filament would be in the vertical axis; that is, as shown by a plumb-bob, a line hanging down, getting the definite position of the screen or its position for the position of the lamp. In this case a vertical line would pass through the center of the lamp.

MR. STETSON: You want the line of sight to run through the center of the strongest illuminant quality of the lamp?

MR. AYER: Well, through the point where useful illumination is developed and where we want the lamp at its best for commercial purposes. The theory is, as everyone realizes, that a lamp gives its most valuable results in the lower hemisphere of it. The lower half of it is what we use for illumination. We do not care much about the upper half, up near the socket. Now, if the lamps under this test can be improved, they will probably be improved in their illuminating qualities, so that you will get a stronger and better luminosity in the distribution of light in the usual and natural positions in which lamps are used.

MR. STETSON: You recommend that the bar supporting the lamp might have a motion that could drop it into the strongest luminous position?

MR. AYER: Not to drop it. The device would be fixed, having a socket that would be spun so that you could revolve it, but at an angle of 45 degrees. If measured horizontally, the candle power may be measured and give a false value to a lamp. It would show strongest in that position, while in this position it would not be so strong with the same lamp. This plan simplifies the method of finding out what you have and what you use; and if this report meets with your approval I want some member of the association to move that its recommendations be adopted. The report calls for further action on the part of this committee for carrying this out. The report is worthless if it is simply accepted and filed, because it means nothing as far as it has gone. Here is a recommendation of the standard, the thing that we were asked last year to do; and I can assure you there has been a lot of work to it. The deductions are all right. They are not oppressive on the lamp manufacturers, but they are certain to improve the standard quality of lamps.

MR. STETSON: I should think you were pretty liberal toward the lamp people in your arrangement of 15 to 17. I do not wish to throw that out as any criticism, because you are very much more thoroughly posted than I am, but simply in the way of a discussnn of the subject. I know that a slight rise in the candle power of a lamp sends up your area of useful work, your hour candle power capacity. You want to be careful not to get it too high, because you may have a lamp that will make that area but be a very short lamp.

SAMUEL INSULL: I move that the report of the committee be accepted, and that the recommendations be adopted by the association, and, if necessary, that the committee be continued.

C. H. WILMERDING: From my recollection, when this committee was appointed there was a provision in the resolution that the Institute of Electrical Engineers should also be consulted.

MR. AYER: The report calls for that. That is part of the whole scheme.

MR. WILMERDING: Do I understand that they concur in the report?

MR. AYER: Well, not in our report, but they make recommendations upon which this report is based, as to determining the standard. They have fixed it and we have made the thing in accordance with their suggestion for a primary standard.

[There was some further discussion, in which J. H. Rhotehamel and J. A. Seely participated, and then President Nicholls put Mr. Insull's motion, which was carried, and the committee was thus formally authorized to continue its work.]

Needs of the Patent Office.

[Washington Correspondence *New York Tribune.*]

Frequent reference has been made in these dispatches to the congested condition of the Patent Office, both on account of inadequate space and lack of suitable facilities for work and the insufficient number of examiners and clerks employed. Attention has also been frequently called to the fact that this condition of things was all the more inexcusable and discreditable because the Patent Office has been for many years past a paying establishment in a pecuniary sense as well as in other respects. In other words, not only has the entire cost of maintenance been paid by the inventors of the country who have had dealings with the office, but they have contributed a surplus which now amounts to between $2,000,000 and $3,000,000. Anybody who did not know how much inertia Congress possesses would naturally suppose that, in view of such a state of facts, sufficient space and suitable facilities would be provided and an adequate force employed to keep the work up to date. So much the inventors of the country whose fees support the Patent Office have a right to demand, but their rights in the premises have been uniformly ignored or denied by Congress.

To such a pass have things come, owing to the lack of a sufficient number of examiners and clerks, that the issues of patents in all divisions of the office are now delayed more than a month, and more than one-fourth of the divisions are from two to three months behind in their work. In one division no less than 1,400 cases are now awaiting action. The number of applications for patents is steadily increasing, as also are the multiplicity and variety of new inventions, and there is urgent necessity, therefore, for new subdivisions of the work of examination and an increase in the force of examiners.

Commissioner Butterworth is fully alive to the situation and its necessities, and he is trying, with the cordial approval and support of the secretary of the interior, to induce the Senate committee on appropriations to insert in the general deficiency bill an appropriation to allow an increase in the force of examiners and clerks sufficient to bring the current work up to date and to prevent further accumulation of arrears. The receipts of the Patent Office on account of fees for the current year will exceed those of last year by $100,000. This fact alone sufficiently indicates that an increase of force is absolutely necessary. It is estimated that an appropriation of less than one-third of the additional receipts will enable the commissioner to meet the increased demands upon his office and put its work on a satisfactory basis.

A Municipal Business Expedient.

It seems that the managers of the municipal plants abroad know how to "hustle" a bit to get business, for over there some of the cities generate electricity to sell as well as for their own use. The *Electrical Engineer* of London tells of a novel phase of corporation electrical enterprise that has just been displayed in Glasgow by the opening of a pleasure resort under the name of the "Scottish Zoo:"

The building is situated just beyond the center of the town, and has been occupied by variety shows, people's palaces, etc., until recently it has been acquired by E. H. Bostock, who has entirely altered the old building and reopened it with all modern improvements, including, of course, electric lighting. Tenders were advertised for to carry out this work, but the corporation electrical department, apparently reluctant to lose such a satisfactory client as these premises promised to be-

come, proposed to put down a temporary gas engine plant and supply the current by meter till such time as their mains were extended to this district. This, we believe, will now shortly be done, seeing that the increase in pressure from 100 to 200 volts gives them a much larger possible area of supply, and we look forward to the close of the present financial year to see large extensions in the mains of the corporation.

The temporary plant which the corporation has laid down consists of a 12 horse power gas engine, driving a dynamo having an output of 105 volts and 120 amperes at 680 revolutions.

The Daylight Work of Central Stations.[1]

By T. C. Martin.

The development of the central station industry has been, in some respects, a disappointment. We have now had nearly 20 years of central station work in this country, and have witnessed an enormous growth in that period within the field of work covered by this organization, but it is apparently as true to-day as when the association was formed that the companies restrict themselves injuriously in their natural and logical advance by remaining mere lighting corporations. What would happen to us all if some new lighting medium came into vogue that deprived us of our illuminating business entirely? If we had to fall back on daylight work, might we not be better off?

That question suggests an extreme view of a rather impossible situation, the fact being that electricity, as an illuminant, gains steadily in public estimation, and has, at this moment, no new rival within speaking distance. But there is vital importance in the opinion of a local company as to whether it exists only to furnish light, or, on the other hand, to supply current for a variety of uses, new and old. My own opinion, modestly expressed, is that the intrinsic value of a company rises just in proportion as it gets off the lighting basis and builds itself up on that of current; just in proportion as it ceases to limit its activities by a moonlight schedule; and, like the British drum-beat, chases the sun with an insatiable, twenty-four-hour desire for more territory and more trade.

A brief retrospect will not be out of place, if followed by a study of the present situation. It is as well not to go back further than 1886, for, although arc lighting is a full decade older than that, the industry 10 years ago took its great leap forward. A careful investigation shows that, in 1886, there were about 410 central stations in this country. Of these, only 300 furnish available statistics, and it would appear that 226 of the companies were then only doing a night arc lighting business. It is safe to assume that all the companies which did not report were in the same category as the 226, so that, out of the 410 local companies, some 325 were doing business only between dusk and daylight, and were standing idle all the rest of the time. In other words, taking the year through, they were idle nearly two-thirds of the day, if the average running be taken at 3,000 hours a year.

To what degree have these conditions been improved in the 10 years? This is an extremely difficult question to answer, but a few tentative figures may be acceptable as a basis for study and discussion. At the close of 1896 there were about 2,400 central stations in operation in this country, so that in 10 years the number had increased sixfold, a gain that is simply stupendous. Of these 2,400, however, 975 had, from the figures obtainable, no day circuits, and 220 others had only arc apparatus, so that 1,195 local companies, by their own admission, were limited to night work. The case is not however, so encouraging as might be implied from these figures. Of the remaining 1,200 companies, only 327 report day circuits, and if it is safe to assume that half of the 900 companies and plants not giving these details were without day circuits, it would appear that, out of 2,400 local plants, at least 1,500 are limited to the night hours for their earning capacity. It must be noted, however, that nearly all the 900 companies not specifying day circuits are operating incandescent circuits, very largely with the alternating current, so that the means for day operation are generally there under more or less favorable conditions.

It is obvious at once that an immense amount of capital and machinery is standing idle that might otherwise be productive of profit and dividends. Of the 1,200 companies confessing that they have no day circuits, only some 780 give their figures of capital and generating capacity in steam or water. It would appear that these plants, with a moderate capitalization of $46,908,000, and with an engine and water-wheel capacity of 164,000 horse power, are standing idle two-thirds of the day and often a great deal longer.

Such figures are given broadly, and may be a little inaccurate in precise detail, but it is the mere fact that is so striking. It is obvious that these figures apply to the great bulk of small stations. And yet some of them are certainly not small. At least 65 or 70 of them have each a capacity of 500 horse power and upward, and several of them are legitimately capitalized at above a million dollars each. A company of such size 10 years ago was rare and exceptional, and would have been difficult to start, except on the general hypothesis that its business would include something beyond simple street illumination, with a little house lighting thrown in. It may be doubted whether capital of any magnitude could be enlisted to-day for a company that had no ideas beyond ordinary lighting work.

Without presenting this state of affairs as a cause for alarm, or intending to imply that a business is necessarily on a bad basis because limited to a few hours, it is not improper to inquire whether there is no chance for improvement. It cannot be said that local lighting companies have become notorious, like some gas companies, for paying large dividends; so that a slight amelioration of financial condition might not be objected to. Even trolley roads, running every hour of the day, find it difficult, sometimes, to make ends meet, but they have the satisfaction of a continuous use of their plant and of knowing that they get all the business that offers. If there is any sufficient reason why a local lighting company should operate its generating machinery fewer hours than a trolley road, it has not made itself specially manifest, except in one direction, which will be briefly referred to in a later paragraph. I believe every gas company is on a 24 hour basis of supply.

If the stationary motor work, whose claims I ventured to urge on this association 11 years ago, had been left to the local lighting companies, I fear it would not have made much headway. The 327 and other companies with day circuits do an enormous amount of power work, but a careful analysis of somewhat incomplete data would lead one to believe that the isolated plants are the real backbone of the electric power industry to-day. Why this should be so, it is difficult to explain, except on the hypothesis that station current, when obtainable, often costs too much, and is generally not obtainable. It will, I trust, be understood that this paper is not offered in any wise as a criticism of central station management, but simply a presentation of the puzzling facts that confront students of the situation. No one can know the inwardness of the problem so well as the central station manager himself, and no one can be more deeply interested than he in dealing with it wisely and well.

It might be said that, in a general survey, four new factors have presented themselves in the last 10 years for the consideration and approval of the central station manager. These are motors, alternating current supply, storage batteries and electric heating. The alternating current is, for most stations, still restricted to night work, and will be, probably, until more single-phase motors of successful character are on the market. This form of current has given such a tremendous stimulus to lighting that it deserves a wider range of usefulness, so that, in time, alternating current stations may compete with direct current stations as earners of dividend.

Allusion has already been made incidentally to motor work. What is possible in this direction is best judged from what the large stations do. Of course, this is in some respects an erroneous guide, but in the same manner as great men are exemplars for those of less heroic bulk, so the large stations indicate the actual possibilities, even for a lower plane of execution. The following are figures of a large western central station, showing the horse power of motors connected to the circuits, and the percentage that the power consumption bears to the total output. The data come down to March 31, 1897:

LOW-TENSION.

Power connected April 24, 1897.....5,396 horse power.
Power per cent. of the total output..... 23.1 per cent.

HIGH-TENSION.

Five hundred volt power con'ted Ap. 24, '97.1,566 horse power.
Power per cent. of high-teosion output..... 21.4 per cent.

ALL SYSTEMS.

Power connected April 24, 1897.....6,962 horse power.
Power p. c. of the total switchboard output. 22.8 per cent.

Another example is to be found nearer home, in the work of the New York Edison company. The motors to which that company supplied current from its distributing mains represented, on January 1, 1896, a total installation of 11,640 horse power. On January 1, 1897, the motors connected were the equivalent of 15,930 horse power, an increase of motors connected in a single year of 4,290 horse power, or 36 per cent. This does not include an installation equivalent to 1,142 horse power in motors, to which current is supplied from the New York Edison stations during minimum hours, or for emergency and break-down connections. It will be seen that this brings the total horse power in motors connected to the company's mains up to 17,072 horse power. The average size of these motors is from 3½ to four horse power. Of the total motors connected it is estimated that about 5,000 horse power, equivalent, is installed in connection with direct electric elevators and grip hoists.

In order that the idea should not go abroad that the big companies are monopolizing the power business, but that it is open to all, I would mention that in Massachusetts, where there is only one large city, no fewer than eight companies out of 58 are supplying power from their arc circuits; 18 from incandescent circuits, and 29 from independent power circuits; the total being about 14,000 horse power of motors on the circuits. The asking rate for kilowatt-hour averages about 20 cents, but runs down as low as 10 cents.

Turning next to storage batteries, it is not my intention to agitate old discussions, but simply to give a few figures, which would go to show that the batteries may do more than perform the Alpine feat of taking care of the peak of the load. There are at the present time in America—I blush to give the figures—only 15 central stations using batteries, with a total capacity of 25,000 horse power hours output. Four other stations are being equipped. I hope devoutly that some future chronicler will be able to report that 1,500 stations are equipped with batteries, and that by their reservoir capacity they have answered in the affirmative the question whether their life was worth living. What batteries can do is best exemplified by the Duane street station of the New York Edison company, one of the biggest stations in the world, with an engine and generator capacity of 20,000 horse power. The load during minimum hours, I am told by Mr. J. W. Lieb, Jr., the general manager of the company, is such that it can be supplied in that period from the storage battery annex at the Bowling Green building in the southern tip of the tongue of Manhattan Island, or from the storage battery plant at the Twelfth street station, either alone or in conjunction with current supplied from the Twenty-sixth street station over the feeder tie lines The supply of stored current from the batteries in the annex stations during the minimum hours enables the big Duane street station to be shut down every night from 10:30 P. M. to 5 A. M.—nearly seven hours; and on Sunday the operation of the generating machinery at Duane street is limited to one watch. I do not hold a brief for storage batteries, but in view of such facts it is hardly possible to do other than press their claims on the attention of central station managers.

A word in conclusion as to electric heating. When I hazarded, 11 years ago, before this body, the expression of an opinion that motors ought to be pushed, it was regarded in many quarters as premature and visionary. From a conservative standpoint, it was so undoubtedly; but in everything success is not to be gauged by the point you are at. The real test is the way you are going; and if the tendency is right, all else that is desirable comes in due time. Now, in central station work, we can and must recognize but one tendency as the underlying and ultimate; namely, to increase the demand for current, and whatever does that is to be welcomed. To-day electric heating, using that term in its generic sense to cover a variety of uses and purposes, stands just where electric power did 10 years ago. It is a parvenu, hardly admitted or recognized in good electrical society, but a "pushing young particle" that there is no snubbing or subduing. Much more recently than 10 years ago I was involved in a hot daily newspaper controversy in New York, with the object of proving that electric power had the ghost of a show; and now the advocates of electric heating are similarly put on their mettle. The main argument they have to contend against is an elaborate formulation of caloric theories and laws, all going to demonstrate the terrific loss and cost of heat units when delivered electrically to the man who wants them.

It is said that, with current sold on the basis of 20 cents a kilowatt-hour, no business can be done in heating, and that, even if the price be cut in two, the inducement to possible customers is not great. If this were true, the matter of price of current might forbid the operation of a single fan motor from central stations. Making a rough calculation of one cent per hour for the ordinary fan motor, that is, 10 cents a day for 10 hours' steady running, or, say, $3 per month or $36 a year; allowing 12 such motors to the horse power, the local companies are selling current to thousands of willing customers in the summer time at the rate of $430 a year per horse power, for a working day of only 10 hours. Other quotations can be made showing the high price got readily for current in small quantities from purchasers who are perfectly satisfied with the bargain, and find it pays them also very handsomely in some element of comfort, pleasure, convenience or even economy.

A test taken three years ago, for 12 weeks, of current consumed in cooking a dinner of several dishes daily for a large number of persons, showed that for 97 persons the current fell as low as 307 watt-hours per person. This would make 29,779 watt-hours, or, in round figures, 30 kilowatt-hours. At 10 cents per kilowatt-hour, that means an expense of $3 per day, or, say, $90 per month. It will, of course, be objected that, in a great many isolated plants, the current made on the spot does not cost to exceed five cents per kilowatt-hour, which would, in the building where the test was made, have brought the sum down to $45. I have tried to get some basis of comparison between this and an equal amount of work on a gas stove or range, for an equal number of persons, but it is not easy to obtain. In one family I know, which consists of six persons, they have been cooking by gas for some five years. It costs, with gas at $1.25 per 1,000 cubic feet, on an average, $5 to $6 per month, or from 16 to 20 cents per day, or about 3½ cents per head per day, if all are at home to every one of the three daily meals, which is far from being the case. If the same expense averaged for the 97 persons for three meals daily, the outlay for gas in cooking would be between $90 and $100 per month, or about as much, if my figures are approximately right, as electricity would cost, if the current were supplied at five cents per kilowatt hour. This is certainly a very encouraging showing for electricity, but we must not forget that central stations do not exhibit much anxiety to sell their current at five cents per kilowatt-hour, or even per horse power hour, and this is one reason why isolated plants have multiplied so tremendously in our cities. I might add, as one point of interest, that, when the family I mention began to cook with gas, it bought a gas range for $25 and paid $2 or $3 more to get it set. The range has worn out, and the family is now hiring a good one from the local gas company for $3 a year.

From these crude remarks of mine, it will be seen how sadly tentative and experimental the art of electric cooking is for most of us; but is it not the duty of the local lighting companies to go into this matter and see how far they can foster the new art, by introducing the apparatus and furnishing current for it cheaply? Even if the price falls short of $430 per horse power per year, for 10 hours a day only, they should not feel discouraged.

I have spoken of cooking, but this is but one of many fields of usefulness for electric current heating supply. Our esteemed ex-president, Mr. J. I. Ayer, who has placed at my disposal much interesting data that I cannot produce here for lack of time, gives me also a variety

1. Presented at the National Electric Light association at Niagara Falls, June 9, 1897.

of information as to work that has lately fallen within his sphere of practical attention as representative of a large electric heating company. Their work includes a wide extent of shoemaking machinery, heated silk-finishing rolls, leather-working machinery, 387 curling-iron sets in the dressing rooms of the combined Waldorf and Astoria hotels in New York city, 72 sets in the Parker House, Boston, and apparatus in the Plankinton and Pfister hotels, Milwaukee, as well as on the American line steamers across the Atlantic. It would not be fair to omit the 14,000 car heaters installed, of one make alone, in the past year and a half. A blank-book manufacturer has had in use since 1894 from 35 to 40 electric glue pots, and Duryea & Co., the starchmakers, are also users of electric heat apparatus. In Knabe & Co.'s piano factory at Baltimore 20 electric heaters have recently been placed, and there is a long list of clothing houses throughout the country that use electric irons. The same is true of vulcanizers for bicycle tire agencies and factories, while irons in large numbers have been supplied to state asylums in Indiana, Michigan, Wisconsin, Illinois, New York, Massachusetts, Maine and Maryland. It is simply impossible that all this apparatus should have been put in unless it was economically or practically worth while; and this being so, is not the electric heat field one in which the local companies can now begin to work with advantage? Surely, here lies opportunity of the largest kind to help the introduction of apparatus that must serve as a large customer for current at all season of the year.

The subjects I have brought up are perhaps inexhaustible, but, in spite of the labor and tax on scant leisure involved in collating some of this data, I shall be repaid if in the smallest degree a stimulus is given to central station work and prosperity. I feel sure that whatever remarks I have made will be accepted in the spirit that prompts them—one of heartiest good wishes for the welfare of the typical comprehensive industry of the age—that of the electric central station.

CORRESPONDENCE.

New York Notes.

NEW YORK, July 6.—Considerable attention has been attracted by the suit of the National Conduit & Cable company against the New York & New Jersey Telephone company, which is controlled by the American Bell Telephone company. The plaintiff owns the patents of the old Norwich Insulated Wire company, giving it, it is claimed, the sole rights in certain improvements in insulating electric conductors, consisting of covering the wires spirally with lapping strips of paper composed of pure vegetable fiber. It is said that this paper-covered wire has been almost universally adopted for long-distance purposes. The Bell Telephone company, it is asserted, has adopted the paper-covered cable in nearly every city in which its telephones are used, and has made itself the patented cable regardless of the rights of the National company. A decision against the Bell company will, it is said, involve the payment of something like $1,000,000 in damages, and probably as much more in costs of one kind and another. The suit comes up in the United States Circuit Court of the Eastern District. Other wire manufacturers are greatly interested in this case.

The Metropolitan Street Railway company has completed negotiations for the lease for a term of 99 years of the branch of the Union Railway company, sometime known as the Huckleberry line, which runs through 135th street, from Eighth avenue to the Madison avenue bridge. In leasing this line the Metropolitan corporation not only pursues its avowed policy of absorbing as many cross-town lines as possible, but acquires a connecting link for its trunk lines on the northern end of Manhattan Island. At present the branch is operated by an overhead trolley, but it is understood that the Metropolitan company will change the motive power to an underground trolley, in order that a perfect loop may be formed with the electric systems it is proposed to establish upon the Madison, Lenox and Eighth avenue lines. The new acquisition will enable the company to extend its operations to the highest part of Manhattan Island. H. H. Vreeland, president of the Metropolitan system, said: "Passengers who disembark from the 138th street station of the New York Central & Hudson River railroad can now reach the West Side of the city for one fare, while we can also reach the Polo Grounds and Manhattan Field and transfer passengers as far east as Second avenue. It will also enable residents in that neighborhood to travel by our trunk lines on the east or west side of the city without being called upon, as before, to walk to 116th street, or pay an extra fare to reach that thoroughfare by horsecars." M. S.

New England News.

BOSTON, July 6.—In the United States Circuit Court in this city Judge Morton has just concluded a hearing on the bill in equity brought by the Consolidated Car Heating company of New York against the American Car Heating corporation, its officers and the West End Street Railway company, asking for an accounting and injunction to restrain the defendants from the alleged infringement of patent No. 500,288, granted to James F. McElroy on June 27, 1893, for electric heaters. The defendants deny infringement. The West End company is using the electric heater made by the American Electric Car Heating company on its cars. Judge Morton has reserved his decision.

Marsden J. Perry, temporary receiver of the United Telegram company, has filed his report in the United States Circuit Court in this city. He took possession of the affairs of the company on February 26th last. The entire amount of cash then on hand was $76.14, and the only book which was turned over to him, or which he has been able to find, is a cash book. This book shows an apparent balance of cash on hand February 23d last of $73,447. An examination of the accounts of the company with the Massachusetts National Bank, where alone it made deposits, apparently, the receiver states, shows that on this last-named day the account had been overdrawn to the extent of $360. The receiver further states: "It appears, however, that the sum of $72,732 was loaned to R. F. Straine, and his notes for this amount, together with 6,500 shares of stock in the United Telegram company as collateral, are held by the receiver." Mr. Straine was an officer of the company when the receiver took charge. The total receipts which the receiver has received are $19,951, and the total disbursements $13 515, leaving a balance of $6,435 on hand. He is running the business. He was authorized to pay $5,000 interest due on the company's bonds and also debts incurred prior to the receivership.

The third season of the Greenacre lectures at Greenacre-on-the-Piscataqua opened July 1st at Eliot, Me., and will continue until the evening of September 3d. This year is considered a most important one for the course, as many scientific men from all over the country will attend the annual meeting of the American Institute of Electrical Engineers, to be held there during the week beginning July 26th. During the electrical conference, July 26th to 31st, the historical loan exhibit pertaining to electrical traction will be opened to commemorate the semi-centennial of the running by Moses G. Farmer of a small electrical car, carrying two passengers, in Dover, N. H., July 26, 1847.

A dispatch from Pennsylvania indicates that New England capitalists are so well satisfied with electric street railway properties that they are willing to go a long way from home to invest in those enterprises. The Easton, Palmer & Bethlehem Street Railway company, with a capital stock of $150,000, has been granted a charter by the Pennsylvania Legislature for a road between Easton and Bethlehem in that state. W. B. Ferguson is the president and Charles Barnes of Plymouth, Mass., is the treasurer. Among the directors is C. A. Richardson of Boston. The incorporators include Frank E. Lowe, Greenfield, Mass., Michael P. McGrath, George A. Murch and Wesley A. Kendall, Worcester, Mass., and N. Sumner Myrick of Boston.

The stockholders of the Manchester, N. H., Electric Light company, at a special meeting held June 14th, unanimously voted to authorize the directors to issue bonds to an extent not exceeding $250,000, at not exceeding five per cent., to retire $80,000 of six per cent. bonds now outstanding and pay for extensive improvements and additions recently made and in contemplation.

The Western Union Telegraph company has not filed a certificate of its condition with the commissioner of corporations at the state house. This fact has stirred up some comment and many inquiries as to the reason therefor. The state law requiring corporations doing business within the limits of the commonwealth to file a certificate of condition is very plain, and a heavy penalty is attached if the law is not complied with. The American Sugar Refining company failed to make its return one year, and there was a lot of trouble. The query at present is this: "Is the Western Union a manufacturing company and therefore exempt from the provisions of the state law?" It is so material that the attorney-general may be called upon once more to bring a foreign corporation into court.

The success of the trolley line to the top of Mt. Tom, the most picturesque peak of the Berkshire Hills, out in the western part of this state, has brought out a proposition to build a similar road up West Peak for Meriden, Conn., and one up Mt. Talcott for Hartford, Conn. The construction is said to be entirely feasible, and the opening up of the lines would give to each of these cities a most attractive mountain park. C. S. G.

Northwestern Notations.

MINNEAPOLIS, July 6.—James H. Windsor, a wealthy citizen of Des Moines, Iowa, has secured a temporary injunction restraining the city of Des Moines from entering into a contract with the McCaskey & Holcomb company for the erection of an electric lighting plant. It is supposed that Windsor is backed by the General Electric company, which controls the three old plants in that city.

Receiver Rust of the National Electric company of Eau Claire, Wis., has wound up the affairs of the company by selling $4,000 worth of outstanding accounts at auction. They brought $53.

E. Peterson, superintendent of the Crookston, Minn., Electric Light company, has invented a mechanical switch for cutting out and turning on electric arc lights without interfering with incandescents where both types are used on the same circuit. The device is placed at the central station and has been tested and proved successful. A patent has been applied for.

Lightning struck the electric light wires at Cedar Rapids, Iowa, and incapacitated the incandescent system of the west side. The arc circuit was uninjured.

The city of Negaunee, Mich., has made temporary arrangements with the old electric light company to furnish street lights while the city plant is being installed.

The formal opening of the electric street railway of the Citizens' Traction company at Oshkosh, Wis., was accompanied by much jollification on the part of the citizens. The system has been in prospect and construction, off and on, for about three years, and the word was given that the plant would be in operation on June 15th. Not till nearly ten o'clock did the machinery respond, but the promise was kept. Invitations to over 1,000 prominent persons were given out to try the new line. It will have 14 miles of road in operation when completed, and will have cost $250,000.

The city of Little Falls, Minn., will appeal the case against the electric light company to the Supreme Court.

In the case of ex-Senator S. Peterson against the Western Union Telegraph company at New Ulm, Minn., for damages for transmitting the message "Slippery Sam, your name is pants," the jury returned a verdict for $1,800. This is the third trial, the first resulting in $10,000 damages, the second for $5,200, and now the third for $1,800. The Supreme Court reversed the second verdict, holding the message libelous but the damages excessive. The message was sent when a United States senatorial election was in progress and Peterson bolted the caucus nominee. The company will again appeal.

The city electrician of Cedar Rapids, Iowa, suggests that the ordinance for electric wires be amended to conform with the rules of the underwriters.

Webster City, Iowa, has abandoned incandescent electric lights for street lighting.

The council committee on light of Iowa City, Ia., will secure an estimate of cost for an electric lighting plant for that place.

R. R. Johnson was granted a franchise for electric lighting at Benson, Minn.

H. C. Payne of Milwaukee announces that he has concluded negotiations with Cleveland capitalists to build an electric line in the Fox River Valley, from Fond du Lac to Appleton, Wis. A portion of the line will be built this year. C.

From Old Virginia.

RICHMOND, July 6.—Washington College, the oldest institution of learning in the South, which was content to get along with the tallow dip in the days of its illustrious founder, Dr. Samuel Doak, is to be lighted with electricity. A plant large enough to brilliantly illuminate the campus and all buildings, including a handsome new church, will be built and operated by water power.

A peculiar accident happened on the 17th to James T. Dudley of Hampton, Va., who was employed as brakeman on an electric car from Newport News to Buckroe Beach. Shortly before reaching Hampton the lighting wire running from the trailer to the motor car became detached, causing a flash of fire, which severely burned his face. He was dazed for a few minutes, but was able to walk to his home some yards distant. Since the accident, however, he has not been able to see at all, and the doctors say that he may lose his sight entirely.

The Port Norfolk Electric Railway company is being taxed to its utmost to provide accommodations for its passengers.

The men interested in the building of the long-distance telephone from Norfolk to Richmond secured the

right of way from Disputanta on the Norfolk & Western railway to within two miles of Petersburg. The poles and wires are up from Norfolk to Wakefield.

The Berkeley Street Railway company has torn up the old switch on Berkeley avenue, preparatory to introducing electricity on the line.

At the last meeting of the Alexandria City Council a resolution requesting the Southern Bell Telephone company to furnish to the city, free of cost, telephones at the jail, station house and city gas works was passed, as was a resolution instructing the finance and light committees to inquire into the cost of engaging an expert gas engineer, whose duty it shall be to thoroughly examine the plant of the city gas works and embody in a report to the council suggestions for any changes and improvements necessary and advisable in the construction and maintenance of the same, in order that gas may be furnished cheaper for household, manufacturing and other purposes.

C. P. Davis, manager of the Richmond Electrotyping company, is experimenting with a new kind of kite known as the Malay kite. He sent up at Riverside five in one bunch. He will soon send up his camera to photograph the surrounding country.

The Bell telephone system has been completed in Salem, and is now in operation. Salem now has connection by telephone with Lynchburg, Roanoke, Chatham, Bedford City and Fincastle. The Interstate Telephone company says that it is coming to Salem and will begin work on its system in a short time.

At the last meeting of the Richmond council committee on streets, in an opinion by City Attorney Meredith, he said that as the city had revoked the franchise of the Bell Telephone company and the matter was in litigation, the city had no right to enforce the conduit ordinance, as far as it affects that company, until the matter was settled. As regards the other electric companies, he is of the opinion that the ordinance can be enforced.

The Manchester City Council has passed an ordinance granting a franchise to the American Long-distance Telephone company.

The Winchester telephone line is now in connection with Rock Enon, and the extension is completed as far north as the West Virginia line. This same company will probably extend its line also from Boyce to White Post.

The Southern States Telephone company will complete its line from through the Western Branch trucking section this week, connecting with the Nansemond Telephone company at Suffolk. It will also in a few days commence extending its lines via Ocean View, connecting with the Hampton & Old Point Comfort Telephone company and the Citizens' Telephone company at Newport News. It will use metallic circuit copper wires, with long-distance instruments.

A joint stock company is being formed to build an electric railway line from Morgantown to Blowing Rock, to be run by electric or compressed air motor power, but more probably the former. Already much of the stock has been subscribed. Y. P.

PERSONAL.

Robert T. Lincoln has succeeded the late Henry B. Stone as president of the Chicago Telephone company.

W. A. Jackson, formerly vice-president of the Central Union Telephone company, has been advanced to the presidency, succeeding Mr. Stone.

The death of E. E. Bogart, son of the late A. L. Bogart, which occurred in New York on June 24th as a result of injuries received by being thrown from a cable car in that city early in February last, is noted with sincere regret by his many friends in the electrical business. Upon the death of his father, Mr. Bogart continued the establishment so long conducted at 22 Union Square, New York, in connection with his brother, A. L. Bogart.

The electrical fraternity in general, and especially the telephone people of the West, will be interested in the announcement that on Saturday, July 3d, Kemster B. Miller, the electrical engineer of the Western Telephone Construction company, was married to Miss Antha Knowlton of Philadelphia. The wedding took place at the home of the bride's mother in Chicago. Mr. and Mrs. Miller started immediately on a trip to California, to be gone about a month. Miss Knowlton is a graduate of Vassar College, but has recently taken up her residence in Chicago to finish her course of studies at the University of Chicago. Mr. Miller graduated from Cornell with the class of '93 and immediately entered the Patent Office, where he remained three years, devoting most of that time exclusively to telephone patents. Early in 1896 Mr. Miller left the Patent Office to enter the service of the Westinghouse Electric & Manufacturing company, but remained there only a short time, as he was offered and accepted his present responsible position as electrical engineer for the Western Telephone Construction company, in which capacity he devotes himself exclusively to expert questions and the Western Telephone company's large patent interests. Mr. Miller has made many friends since his coming West, and he will be heartily congratulated.

ELECTRIC RAILWAYS.

The trustees of the village of Depew have granted the application of the Buffalo & Depew Railroad company to build its line within the corporate limits of that village. They promise to go right ahead with the road.

A joint resolution has been introduced in the United States Senate by Mr. Penrose, granting permission for the electric railway line, at present running from the Aqueduct bridge to Fort Meyer and Arlington, Va., to be extended to the Washington end of the Aqueduct bridge, the work to be done with the permission and under the direction of the secretary of war. The cost of the extension is to be paid by the railway company.

The Milwaukee Street Railway company has perfected plans whereby it will have an electric line in operation between that city and Waukesha within 60 days. Next season the line will be extended to Pewaukee and Oconomowoc. A narrow railway coach will be used, with motor and trolley attachment. This action by the Milwaukee company has caused the abandonment of plans by two other companies organized for this special purpose.

The Saratoga Northern Railway company has been incorporated with the secretary of New York state with a capital stock of $1,000,000. The company proposes to construct an electric railroad from Saratoga Springs to the village of Wilton and to Mt. McGregor in Saratoga county, a distance of 11 miles. The directors are A. C. Kaufman, Harrison Hale Schoff, Edward A. Maurice, of Pittsfield, Mass.; J. B. Robertson of New Haven, Conn.; C. E. Arnold, H. McGonegal, L. C. Jordan, of New York city; A. J. Voyer of Albany, and J. R. Hampton of Philadelphia.

TELEPHONE.

Mayor R. J. Saltsman of Erie, Pa., has affixed his name to the conduit ordinance, and it is now a law. This ordinance provides for the construction of a conduit through the line of the principal streets for the use of all low-tension wires, the object being to free the streets from the telephone and telegraph wires. State street is especially crowded with wires. The old telephone company opposes the conduit step on the ground that the city has not the legal right to expend the public money for a conduit, while the new Mutual Telephone company is in sympathy with the conduit movement. The bids for the work are about to be asked for.

The Chicago Telephone company calls attention to the fact, that owing to the general observance of the Saturday half holiday and the consequent rush of business during the morning hours of that day, subscribers will expedite their own calls and avoid "busy" calls to a greater extent by extending the period of use of their telephones over as large a number of hours as possible. "A very great number of subscribers now attempt to do all the morning's telephoning between the hours of 10 and 11," it is stated. "As a result, many unavailing calls are made for lines which are almost continuously busy during that hour. By beginning the morning's business which is accomplished by telephone at an earlier hour and extending it at a more even rate up to 12 o'clock, the service will be expedited. Subscribers whose telephones are of greatest value for receiving calls are recommended to keep their lines as free as possible for that purpose and to avoid blocking them by outgoing messages. Subscribers who have more than one trunk line or telephone are recommended to keep one line free for incoming work as much as possible."

POWER TRANSMISSION.

Contracts have been let in San Francisco for what is, in many ways, the most remarkable electrical power transmission ever undertaken. The amount of power to be transmitted is about 4,000 horse power, but the distance from the power house to the distributing station, according to the *Pacific Electrician*, will be 81 miles, which is over twice the length of any transmission line now in operation. The current will be transmitted at a pressure of 33,000 volts, the highest voltage hitherto used, 15,000, being on the lines of the Central California Electric company, from Newcastle to Sacramento. The electrical equipment will be furnished by the General Electric and the Westinghouse companies. The Southern California Power company, which is putting in the plant, controls most of the available water powers in the vicinity of Los Angeles, and from advices received from Southern California it is evident will shortly absorb the San Gabriel plant, upon which work is now being done, and thus practically control the electrical field in the southern part of the state. The shareholders in the company have recently secured control also of the Los Angeles & Pasadena Railway company, the Los Angeles & Santa Monica Railway company, the Pasadena Electric Light & Power company and the West Side Lighting company of Los Angeles.

MISCELLANEOUS.

Niagara Falls has a new industry in the shape of a hair-cloth factory, which has been started by McSloy Brothers of St. Catherines, Ont. They will use electric power furnished by the Niagara Falls Hydraulic Power & Manufacturing company, and have leased a part of the fourth floor of the Pettebine-Cataract Manufacturing company's property on the canal basin.

The Cataract Power & Conduit company of Buffalo has given the Metropolitan Trust company of New York a mortgage of $2,000,000. It bears interest at 5 per cent., payable semi-annually, and is to become due not more than 30 years from date. It will be secured by 2,000 bonds of $1,000 each.

The Underground Electric Wire company of Syracuse has been incorporated in New York state with a capital stock of $400,000. The company proposes to produce and supply electricity and to construct overhead and underground structures for the purpose of stringing wires. The directors are: William B. Kirk, Charles Hughes, Eugene Hughes, Peter J. Mack of Syracuse, Anson M. Bangs of New York city, John F. Gaynor of Fayetteville, N. Y., and Benjamin D. Green of Stamford, Conn.

The regular monthly meeting of the Cincinnati Electrical club was held on Thursday, July 1st, at the club room in the College building. H. S. Rogers, division engineer of the General Electric company, presented an interesting paper on the monocyclic system, in which he set forth the various systems of alternating current transmission now in use, together with the advantages and disadvantages of each. The club decided not to hold the regular monthly meetings during August or September, but the club room will be open at all times to members.

TECHNICAL SCHOOLS.

The University of Notre Dame (Ind.) is extending its electric lighting plant on account of the erection of new buildings, which are to be lighted by electricity. The work is in charge of J. J. Green, professor of physics and electrical engineering at the university.

At the thirty-fifth convocation of the University of the State of New York, "The Place of Electricity in a College Curriculum" was discussed by Brother Potamian of Manhattan College, E. L. Nichols of Cornell University, W. L. Stevens of the Rensselaer Polytechnic Institute and Charles W. Hargitt of Syracuse University.

Twenty men were graduated in the course in electrical engineering at the recent commencement of the University of Michigan. The following are the subjects of their theses: "Design and Construction of a 1,250 Watt Transformer;" "Test of a Thompson-Ryan 100 Kilowatt Direct Current Generator;" "Iron-clad Lifting Magnet;" "Hopkinson's Apparatus for Finding Hysteresis in Straight Bars;" "Comparison of the Alternating and Continuous Current Methods of Measuring Electrolytic Resistances;" "Investigation of the Enclosed Arc Lamp;" "Test of 220 Volt Incandescent Lamps;" "Construction and Test of a 1,500 Watt Polyphase Alternator;" "Test of Primary Cells for Efficiency;" "Electricity Direct from Coal."

TRADE NEWS.

The Mississippi Telephone company has removed its shops from Hazlehurst, Miss., to Wesson, Miss.

One hardly knows which to admire the more, the sturdy patriotism or the ingenuity displayed in the Fourth of July souvenirs of the American Electrical Works of Providence. This year the words of "The Star Spangled Banner" are given, and a silken American flag is shown in undaunted triumph over the ramparts which were the scene of the poem. The flag is on one card and the printed stanzas on another, and the two are tied by a dainty white ribbon.

The H. M. Underwood & Co. duplex lamp guard factory was destroyed by fire the early part of last week, which will make from two to three weeks' delay in shipping present orders. About 200 gross of guards were in the shipping room boxed ready to be shipped and were lost. The business of this firm has grown to such an extent that on and after July 15th the manufacturing department will be run under the name of the Duplex Lamp Guard company, making two departments of the business. The new factory will be located at 69 and 71 West Jackson boulevard, Chicago. The outlook for business in the Cloos high-potential junction boxes for the next six months is more than encouraging, and owners of lighting plants and central stations all over the country are taking the matter up with a view of installing these boxes.

Although it is only a week since the Westinghouse Electric & Manufacturing company made the announcement that it had obtained a very large contract for power transmission apparatus from the St. Lawrence Construction company of New York, it has now been learned that a few days ago the Westinghouse people secured another contract for electrical apparatus which, while not so large, is of equal importance. This is a contract from the Boston Terminal company, which is now constructing the Southern Union Depot at Boston, Mass. It is the intention of the managers of the new union depot not only to handle the largest number of trains entering any station in the world, but to handle them in the most complete and efficient manner. All the modern devices of interior motive power for heat, light, electric power, signaling, elevator work, refrigeration, ventilation, etc., will be taken advantage of in the equipment of this gigantic undertaking, and the Westinghouse interests have obtained the entire contract for doing all this work. In this fact lies an important feature of the contract, because it was found by the management that it was necessary, in order to obtain uniform work, to put the entire matter into the charge of one firm; and as the Westinghouse interests, as manu-

facturers of steam engines, electrical machinery and signaling apparatus, were the only ones bidding for this work in a position to undertake it all, the management of the Terminal company decided for that reason to entrust the Westinghouse company with the work. President Charles P. Clark, of the New York, New Haven & Hartford railroad, says: "We awarded the contract to the Westinghouse company because it is the only concern that could cover the whole field. Any subdivision for the engineering of construction the company will attend to, and thus it should be able to connect and centralize all the heat, light and power economically. We expect to be in the new union station in 1898." It is understood that this contract amounts to over half a million dollars.

BUSINESS.

The Boston Motor company issues a compact catalogue of experimental electrical supplies, with tables and formulæ, and also states that it is prepared to do all kinds of experimental or model work.

All of the wire used in the electrical equipment of the R. R. Donnelley & Sons company's printing establishment in Chicago was furnished by the Simplex Electrical company, of which H. R. Hixson is the western selling agent.

The Detroit & Cleveland Steam Navigation company is making special tourist rates to Mackinac from Cleveland, Toledo and Detroit. An illustrated pamphlet will be sent for two cents by A. A. Schantz, general passenger agent, Detroit.

At the Tennessee Centennial Exposition seven different sizes of Otto gas engines, ranging from three to 45 horse power, are shown in running order, representing all types of engines—stationary, marine and portable—built by the Otto Gas Engine Works of Philadelphia.

Secretary F. B. Platt of the Ansonia Electric company, Ansonia, Conn., has returned from one of his extended trips through the central and western states, and reports that he is very pleased with the results. He thinks that there is a decidedly improved tone in business, which points toward a lively fall trade in his line of business. Mr. Platt states that at no time during the year has trade looked so favorable for the future as at present.

While the Stromberg-Carlson Telephone Manufacturing company of Chicago is having an excellent business in its public exchange and toll-line apparatus, it also reports a great increase in demand for intercommunicating and central station interior systems for isolated plants. The field is not confined to large business houses and hotels, but is rapidly being extended to private residences, schools, charitable and reformatory institutions, prisons, etc. One reason for this company's prosperity in this line is the fact that its instruments have demonstrated themselves to be thoroughly practical and durable, and they are said to be free from infringement.

Business is good with the Ridgway (Pa.) Dynamo & Engine company, which is fitting many plants with McEwen engines and Thompson-Ryan dynamos. The June sales include one tandem compound engine for Purdue University; one 150 kilowatt plant for Northwestern Mining & Exchange company; two 75 kilowatt direct-connected plants for the University of Michigan; two 50 kilowatt generators for the city of Buffalo, N. Y., two 75 kilowatt generators direct-connected to tandem compound engines for Tulane Hotel, Nashville, Tenn., and one 10 kilowatt plant for W. H. Brown & Son, Pittsburg, Pa. The order from the University of Michigan was secured in the face of active competition, as 23 concerns figured on the plant.

George W. Lord of 316 Union street, Philadelphia, makes a rather unusual offer: "Lord's boiler compounds are in use by the largest manufacturing establishments everywhere; they are exported to all foreign countries where steam is used; they are favorably mentioned in our best modern works on steam engineering as a safe and reliable remedy for the removal and prevention of boiler scale and also as a complete remedy for pitting and other forms of corrosion in steam boilers. To prove this statement, and at the same time help our customers to the information contained in these valuable scientific works, we will send you any of these books by mail, free of postage, at publisher's price, or free of cost with a trial order, providing, of course, the order calls for a reasonable shipment."

The F. & L. flush push-button switch is the Electric Appliance company's latest specialty. This switch, which must be seen to be appreciated, is a very simple and compact device, the size of the face plate being no larger than an ordinary two-button gas key. The face plate is nickel-plated with pearl buttons. One of the merits of the switch is the ease with which it is operated. It is also a less expensive switch to make than any first-class push-button switch ever offered heretofore, and the Electric Appliance company is thus enabled to offer it at even a lower price than the regular snap flush switch. It is at present made only in single-pole style, with a capacity of five amperes, although other sizes and capacities are now in preparation. The F. & L. flush switch promises to find a large and useful field.

One of a comparatively few strictly high-grade engines for electrical purposes is the Ball automatic engine, built by the Ball Engine company, Erie, Pa. This engine's beginning was almost identical with that of the electric light business, and there are many stations where Ball engines that have been running from 10 to 15 years are giving good satisfaction to-day. The present management, with the experience of 15 years building engines for electrical purposes, has brought the engine to the highest degree of perfection, and the large works of this company are very busy. In addition to its extensive business all over this country the company is shipping a number of engines to foreign countries. A late order is that from the Mount Vernon company, Woodberry, Md., which recently purchased a 100 horse power Ball automatic engine, being the second order for this make of engine.

The first large underground work in St. Louis is now under way, and the Standard Underground Cable company of Pittsburg, New York, Chicago and St. Louis has recently secured from the Bell Telephone company of Missouri and the Kinlock Telephone company (both of St. Louis), two of the largest contracts ever let in this country (and probably in the world) for telephone cables; these two orders comprising all the underground work in St. Louis yet contracted for, and constituting the complete cable equipment for both telephone companies. Both contracts were secured in the face of severe competition, and the excellence of the telephone cables manufactured by the Standard Underground Cable company largely influenced the placing of the order, as the prices were exceedingly close. To fill these contracts there will be required more than 650,000 feet of cable, which in turn requires about 100,000,000 feet of No. 19 B. & S. copper wire and 2,000,000 pounds of lead. To meet this extraordinary demand, the manufacturing facilities of the cable company in the paper-covering department have recently been doubled, which places it in a position to not only handle this volume of business rapidly and easily, but at the same time to fill without any delay the large and constantly increasing orders for telephone cables, electric light and power cables, rubber insulated wire, etc., which are being daily entered. Considerably more than one-half of this cable will be installed by the cable company; it has contracted to turn the cable system of the Kinlock company over to that company complete and ready for service. A large force of expert workmen will be employed for nearly a year in this work, under the direct supervision of the St. Louis office.

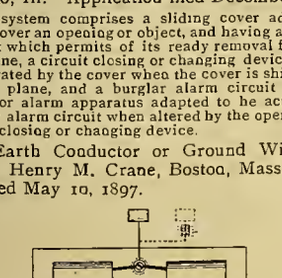
ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued June 29, 1897.

585,171. Burglar Alarm System. William T. Arnold, Chicago, Ill. Application filed December 15, 1896.

The system comprises a sliding cover adapted to be placed over an opening or object, and having a mounting or support which permits of its ready removal from its normal plane, a circuit closing or changing device adapted to be operated by the cover when the cover is shifted from its normal plane, and a burglar alarm circuit including a signal or alarm apparatus adapted to be actuated by the burglar alarm circuit when altered by the operation of the circuit closing or changing device.

585,185. Earth Conductor or Ground Wire Attachment. Henry M. Crane, Boston, Mass. Application filed May 10, 1897.



NO. 585,287.

A slotted metal angle piece with a threaded perforation through one of its faces is combined with a metal strip secured at one end to the outside of the perforated face, arranged to pass twice in opposite directions through the first slot, and once through the other, and adapted to surround the grounding pipe between the points passing the first slot; there is also a tightening set-screw associated with the threaded perforation of the angle piece, and impinging upon the metal strip between its fixed end and the nearest slot thereto.

585,229. Apparatus for Applying Heat to Thermo-batteries. Harry C. Reagan, Jr., Philadelphia, Pa. Application filed May 15, 1896.

The combination with a locomotive boiler, carrying a pumping device and having a stack and smoke-box, of a thermo-battery surrounding the smoke box, a water-jacket surrounding the battery, a connection intermediate with the pumping device and water-jacket and an overflow or outlet for the latter.

585,249. Electric Clock. Robert Baumann and Theodore H. Wurmb, St. Louis, Mo. Application filed May 18, 1896.

An electrically controlled clock mechanism is described.

585,250. Combined Electric Fan and Electrolier. Edwin H. Bennett, Jr., Bayonne, N. J. Application filed June 14, 1893.

The lamp-holder in this fixture is detachably connected with the central support, so that the lamps carried thereby may be removed from the fan collectively by detaching the holder.

585,255. Contact Box for Electric Railways. William M. Brown, Johnstown, Pa. Application filed July 18, 1896.

One claim describes a receptacle adapted to be removably secured within the contact box, the receptacle being sealed, a fluid conductor within the receptacle and in electrical circuit with the source of supply, a solid electrical conductor floating or immersed in the liquid conductor, the solid conductor being adapted to be put in circuit with the contact portion of the contact box.

585,257. Electric Meter. Frank P. Cox, Lynn, Mass. Application filed March 6, 1897.

A meter for registering at different rates at different times, consisting of a single motor mechanism and single registering mechanism, and means for controlling the speed of the motor for a given load from a point distant from the meter, as, for example, from the station or a substation.

585,258. Electric Metering Apparatus. Frank P. Cox, Lynn, Mass. Application filed March 6, 1897.

The first claim describes an electric metering apparatus, comprising a number of recording devices giving independent readings, one of the devices being arranged to operate and continuously record all the electrical energy consumed, and means for periodically throwing the other measuring device out of and into operation at predetermined times.

585,264. Apparatus for Filling Bottles. Josiah H. Fahrney, Chicago, Ill. Application filed October 8, 1895.

The valves regulating the flow of liquid to the bottles are controlled by electro-magnets.

585,265. Apparatus for Filling Bottles. Josiah H. Fahrney, Chicago, Ill. Application filed October 8, 1895.

The combination of a reservoir, a supply pipe therefor, a valve in the supply pipe, a valve-rod connected to the valve and extending upwardly, a magnet having a hollow core to receive the valve-rod, an armature on the upper end of the rod and above the magnet, a retracting spring mounted on the rod and suitably housed within the core of the magnet, a battery, electrical connections from the battery to the magnet, and a float arranged within the reservoir and adapted to close the electric circuit and energize the magnet to shut the valve in the supply pipe.

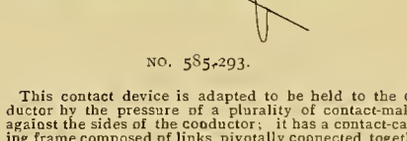
585,267. Electric Trolley Device. Alfred J. Gairing, Johnstown, Pa. Application filed December 26, 1896.

The combination of a lazy-tongs frame carrying a transverse shaft in proximity to the conductor, and having a plurality of diverging members forming each of its four sides, the two lower sides being pivoted near their lower ends about a common transverse axis, and spring devices secured to each of the lower sides below its pivotal point.

585,287. Ground Detector. Edwin W. Rice, Jr., Schenectady, N. Y. Application filed March 1, 1897.

An electrostatic device having a system of stationary inducing plates, some of which are connected to one side of the line and others to the other side, with a second set of plates maintained at equal potential and insulated from the first, and an indicating device in inductive relation to the stationary plates.

585,293. Electric Contact Device. Solomon H. Stahl, Johnstown, Pa. Application filed February 23, 1897.



NO. 585,293.

This contact device is adapted to be held to the conductor by the pressure of a plurality of contact-makers against the sides of the conductor; it has a contact-carrying frame composed of links pivotally connected together, the pivotal connections being adapted to be located beneath the conductor and alternately at each side of the vertical plane in which the conductor is suspended.

585,301. Electric Tower Clock. Theodore H. Wurmb and Robert Baumann, St. Louis, Mo. Application filed May 18, 1896.

These features are enumerated in the first claim: A switch connected to and operated by rocking armatures, which switch consists of a lever pivoted at one end, a bar connected to the rocking armatures and operating transversely of the free end of said lever, a pin fixed in the end of said bar and operating in the slot in the free end of said lever, a lug attached to the free end of said lever, a pin transversely fixed to said lug, contact points upon the opposite ends of said pin, springs fixed to the base of the machine by posts, the free ends of said springs being positioned adjacent said contact points, set-screws for adjusting the free ends of said springs, and suitable electrical connections.

585,307. Electric Dynamo or Motor. Charles E. Emery, Brooklyn, N. Y. Application filed April 20, 1893.

An electric dynamo or motor, without field coils, provided with an armature, a commutator, commutating brushes, a permeable yoke and pole-pieces attached thereto, with the width and length of the faces of such pole-pieces so pro-

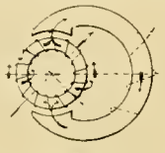
portioned and the angle of commutation so adjusted by shifting the brushes that the required number of turns of the armature (counted on one side) will be included in the double angle of commutation to produce, with the current flowing in the armature, the desired number of ampere-turns of exciting force to produce the field.

585,308. Electric Broiler. George B. Fraley, Denver, Colo. Application filed October 28, 1896.

This utensil consists of a hollow standard, a hollow shaft rotatably mounted thereupon, blocks of fire-brick or other suitable material, means for holding the blocks in assembled position, conductors embedded in the blocks, supporting devices for the material to be broiled, and wires leading through the hollow standard and shaft to and from the terminals of the conductors, whereby the blocks are heated.

585,309. Electric Heater. George B. Fraley, Denver, Colo. Application filed October 28, 1896.

A block having a substantially upright channel therein, independent elements of conductive material located in the channel, means for causing the elements to contact with each other throughout the operation of the heater, and means for supplying electricity to the elements.



NO. 585,307.

585,310. Alternating Current Electric Heater. George B. Fraley, Philadelphia, Pa. Application filed April 27, 1897.

The apparatus described consists of a sheet of suitable conducting material wrapped upon itself, forming a core and electrically connected at the ends thereof, insulation between the convolutions of the core, a primary coil surrounding the latter and insulated therefrom, a support engaging the lower portion of the core and having a connection to the primary coil, a support for the upper portion of the core but insulated therefrom, the support having also a connection to the primary coil, a connection extending from the upper support and sustained upon a portion of the lower support but insulated therefrom, and means for conveying electricity to and from the supports.

585,311. Electric Heater. George B. Fraley and Amos B. Paulson, Philadelphia, Pa. Application filed September 21, 1896.

The combination of a metallic core, slotted for a portion of its length, and an insulated resistance coil wound around the core.

585,316. Electric Arc Lamp. Philip H. Klein, Jr., New York, N. Y. Application filed March 20, 1897.

The globe tapers toward that extremity by which it is to be attached to the lamp frame; there is a two-part thimble located within the globe, provided with a screw-thread by which it may be screwed onto the lamp frame, and with enlarged ends which, when the parts of the thimble are assembled in position, bear against the inner tapering portion of the globe and its outer end respectively.

585,317. Electric Arc Lamp. Philip H. Klein, Jr., New York, and Erwin Lavens, Brooklyn, N. Y. Application filed November 9, 1896.

The first claim is given: The support for the globe, the hanging rod bearing such support and lugs at the upper end of such hanging rod, in combination with a supporting bracket having cuts and seats to receive said lugs on the hanging rod, said seats being higher on one side than on the other, and a stop-pin on said hanging rod so placed as to prevent said lugs being lifted over the higher sides of said seats.

585,318. Electric Arc Lamp. Erwin Lavens, Brooklyn, N. Y. Application filed March 20, 1897.

In an inclosed electric arc lamp, the combination of the lower carbon-holder, which has a vertically bored-out portion for reception of the carbon, the sliding pivoted cover for the lower end of the carbon-holder, and means for pressing the sliding cover against the bottom of the carbon-holder to secure an air-tight covering therefor.

585,319. Telautograph. Leon O. McPherson, Highland Park, Ill. Application filed November 24, 1896.

The combination of a line wire, means for causing pulsations to traverse the same, and a governor operating to change the strength of current on line to compensate the effects of changes in frequency of the pulsations.

585,321. Insulating Joint. Louis F. Van de Wiele, Brooklyn, N. Y. Application filed October 14, 1896.

An improved insulating joint having a yoke, two insulating disks fitting upon each other, a hickey which fits between the disks and is insulated by them from the binding-pin and the yoke, and a binding-pin which carries the insulating disks in the yoke.

585,342. Electric Train Signal. Myron W. Parrish, Detroit, Mich. Application filed November 7, 1896.

A signaling system, comprising two circuits, a signal, a source of electric energy, spool magnets, a pivoted muffling armature, and a permanent magnet adapted to be adjusted to any number of volts and to lock the muffling armature when the signaling circuit is broken.

585,350. Bracket for Incandescent Lamps. Herman Noreck, Charlottesville, Va. Application filed March 5, 1897.

This bracket consists of one tubular section through which the wires extend, this section having an exterior screw-threaded neck, and an overlapping guard surrounding the neck and forming a space between the two, and another section to form a hood to receive the socket of the lamp, this latter section having an interior screw-threaded neck which fits in the space between the exterior screw-threaded neck and the guard, and engaging with the threads of the former.

585,355. Process of Obtaining Metallic Zinc and Copper from Ores. Charles A. Burghardt and Gilbert Rigg, Manchester, England. Application filed June 1, 1896.

The improved process of recovering metallic zinc from zinc ores, which consists in treating the roasted and ground ores with an ammoniacal solution, then in precipitating the iron dissolved in the resultant liquid by the addition of hydrated oxide of tin, and in finally effecting the electrolytic deposition of the metallic zinc.

585,359. Process of Obtaining Porous Metals by Electrolysis. Ludwig Höpfner, Berlin, Germany. Application filed October 5, 1896.

An electrolytic process of obtaining a composite metal plate, which consists in electrically precipitating a porous or spongy metal, and stiffening the same by precipitating thereupon a denser metal.

585,371. Motor Vehicle. Clinton E. Woods, Chicago, Ill. Application filed May 8, 1896.

The last claim reads: In a vehicle, the combination of two motors with separate braking devices, a single brake-controlling device and an evener or equalizer, whereby the one controller is connected with the two brakes.

585,379. Dynamo-electric Machine. George E. Dorman, Chicago, Ill. Application filed February 4, 1896.

The armature is provided with a series of poles having coils thereon; a series of field magnet poles is arranged around the armature; one end of the coils of the armature is connected together, the other end of each coil being connected to a section of a commutator; a conducting device is associated with the commutator, and the connected ends of the armature coils are arranged so as to short-circuit one or more of the armature coils at a predetermined point.

585,380. Trolley Guard. Wallace C. Dunham, Indianapolis, Ind. Application filed December 27, 1895.

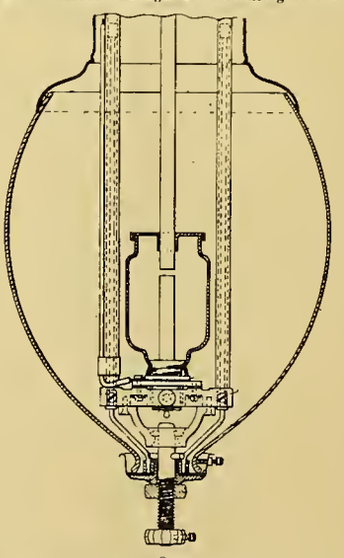
An automatically-acting wire catching and restoring device is provided with fingers and located alongside the trolley wheel, with its catching-face normally below the groove in the trolley wheel and arranged to rise above the groove by force imparted from contact with the wire after catching it.

585,387. Electrolytical Diaphragm. Carl Kellner, Vienna, Austria-Hungary. Application filed August 18, 1894. Patented in Austria April 6, 1894; in Germany April 19, 1894; in Switzerland April 19, 1894; in France April 19, 1894; in Belgium April 19, 1894; in England April 19, 1894; in Norway April 19, 1894; in Sweden April 23, 1894; in Hungary May 14, 1894, and in Italy June 30, 1894.

A diaphragm for electrolytic apparatus composed of a slab of soap.

585,444. Rheostat and Circuit Controller. Harry W. Leonard, East Orange, N. J. Application filed November 24, 1896.

The combination in an automatic circuit controller of an electro-responsive device connected across the terminals of a translating device, so as to be subjected to the same electromotive force as the translating device, a circuit controller held by the device in a definite position under normal conditions, and which device releases the controller when the electromotive force at the terminals of the translating device is abnormally low, means for effecting the release of the controller when the current through the translating device is abnormally large, and means for operating the controller when so released to prevent or reduce the flow of current through the translating device.



NO. 585,317.

585,472. Secondary Battery. George E. Hatch, Quincy, Mass. Application filed April 28, 1896.

A secondary battery, consisting of a conducting electrode and a receptacle therefor, providing spaces between the electrode and the walls of the receptacle, the receptacle consisting of opposite plates having their inner faces grooved in proximity to the edges, and packing strips inserted into the grooves, into which they fit snugly, so as to be laterally confined, and thereby held in place when the side plates are detached from each other.

585,473. Secondary Battery. George E. Hatch, Quincy, Mass. Application filed April 28, 1896. Renewed March 11, 1897.

This battery has one or more pairs of supports, the rear faces of which are provided with projecting ribs, and their inner faces with pockets, to which supports the active material is applied, and by which it is sustained by contact with the interposed conducting electrode, each of the supports being composed of a number of plates of stiff, porous earthenware disposed edge to edge, bearing surfaces being formed between the separate plates of greater width than the average thickness of the plates.

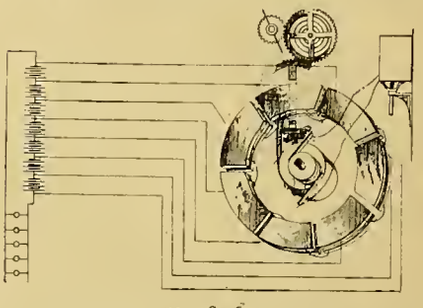
585,480. Electric Time Alarm. Alvah C. Roebuck, Chicago, Ill. Application filed July 27, 1896.

A time-alarm, comprising a graduated dial driven by clockwork and carrying adjustable arms adapted to be set to the time when the alarm is to be sounded, and a lever adapted to be actuated by the arm to move a contact point on the lever in the path of the contact point on the minute-hand of the clock to close the circuit.

585,507. Circuit Breaker for Electric Wires. Andrew J. Clark, Lexington, Ky. Application filed November 21, 1896.

This circuit-breaker is adapted for a suspended electric wire, and comprises vertical levers, each having a contact plate extended from its lower end and at right angles to the levers, and a block of insulating material to which the upper ends of the levers are pivoted, the longitudinal axis of the pivot being arranged at an obtuse angle transversely to the contact plates.

585,511. Circuit Controller for Electric Motors. Henry H. Cutler, Chicago, Ill. Application filed January 8, 1897.



NO. 585,620.

The combination with a circuit-controlling arm or element of a retaining electro-magnet for locking the same in position, means for moving the same when released to alter the condition of the circuit, a releasing electro-magnet for de-energizing the retaining electro-magnet upon the flow of an abnormal current, and means for adjusting the releasing electro-magnet to cause the same to respond to a predetermined current strength.

585,512. Circuit Controller for Electric Motors. Henry H. Cutler, Chicago, Ill. Application filed January 8, 1897.

To lock the circuit-controlling arm or element in position a retaining electro-magnet is employed. This magnet is provided with opposed windings. Means for moving the circuit-controlling arm when released are provided, and there is a releasing electro-magnet designed to normally maintain one of the windings of the first-mentioned magnet out of operative condition.

585,527. Electric Motor. Charles Lindberg, Duluth, Minn. Application filed February 24, 1896.

An internal armature is provided with grooves in its periphery, and independently removable magnets arranged about the same, each of these magnets consisting of three approximately vertical webs connected by an approximately horizontal web, so as to form a double diverging spool, one of the vertical webs being deeper than the others for engaging the grooves in the armature to assist in holding the magnets in proper place.

585,560. Electric Telephone. Cleaveland F. Dunderdale, Chicago, Ill. Application filed January 7, 1895.

The claim is given: In a telephone receiver, a gravity switch therefor, consisting of a chamber divided into two compartments located in the interior end of the receiver, a movable ball contact-maker normally resting within one compartment of the chamber when the receiver is not in use, leads of the signal circuit terminating in said compartment, whereby the said circuit is normally completed by said movable ball contact, and leads of the talking circuit terminating in the other compartment of said chamber, whereby when the receiver is tilted in use the movable ball contact shifts from one compartment into the other, thereby disestablishing the signaling circuit and establishing the talking circuit.

585,579. Trolley for Electric Cars. John C. Kellogg, Lexington, Ky. Application filed September 25, 1896.

The combination with the harp and trolley wheel and axle, of the arms pivotally connected intermediate their ends to the axle, the flaring fork at the upper ends of the arms, the bail or yoke pivotally connected with the lower ends of the arms, and the spring-arms secured to the fork and bearing against the wheel.

585,602. Trolley for Electric Railways. Victor Thélin, Geneva, Switzerland. Application filed November 30, 1896. Patented in Switzerland May 16, 1896.

A trolley pole and supporting device designed to turn automatically into correct position when the motion of the car is reversed.

585,603. Electric Arc Lamp. Christian J. Toerring, Jr., Washington, Pa. Application filed January 2, 1896.

An arc-inclosing globe, a mounting for the same permitting lateral movement of the upper end of the globe, and a cover having a hole for the passage of the upper carbon, are the features of this invention.

585,620. Electric Accumulator System. Harry B. Cox, Hartford, Conn. Application filed November 10, 1893. Renewed November 7, 1896.

The first claim reads: In an electric accumulator system, the combination of two concentric rings of insulated contacts forming pairs of opposite contacts, sets of accumulators, direct electric connections between the contacts of one ring and said sets of accumulators, direct electric connections between each contact of a pair with the electrically opposite contact of an adjoining pair, an insulated member concentrically within the ring and provided with two insulated brushes sliding in electrical engagement with the inner edges of the contacts of the two rings respectively, a source of electrical energy of which said brushes form the opposite terminals, and driving means shifting the electrical contact between the brushes and each pair of contacts at regular intervals, so that the current of the generator is concentrated on each set of accumulators in regular succession.

Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, JULY 17, 1897. No. 3

Chicago City Railway Company's New Electric Power Plant.

When, in the issue of February 20th last, the WESTERN ELECTRICIAN gave a brief general description of the new power house of the Chicago City Railway company at Forty-ninth street and Oakley avenue, the work on the machinery was not far enough advanced to make it practicable to present interior views of this large and impressive plant. These are now given, although there still remain finishing touches before the plant now installed (half the ultimate capacity of the station) can be considered complete. The six views on this and succeeding pages are intended to supplement the picture of the exterior and the plan and transverse section drawings given in the preceding article. Fig. 1 represents the general appearance of the engine room, with a far glimpse of the switchboard, and gives an idea of the size of the plant. Fig. 2 is another view of this room from the generator side. This photograph was taken from the switchboard balcony. Fig. 3 shows the vista down the boiler room, while the great switchboard is represented in Figs. 4 and 5, the latter showing the back of the board. Fig. 6 gives an idea of the subway leading out from the basement of the station, through which the feeder cables are led under the sidewalk of Forty-ninth street to steel poles.

The plant is a simple, non-condensing one, but is of large size, and everything about it is planned on the most generous scale. It has been criticized as uneconomical because it was not designed with compound condensing engines, but on the other hand it is insisted that at the usual price of fuel at this station, which is well located to obtain cheap coal, the saving would not equal the interest on the increased investment of the more expensive plant. It is expected by those in charge of the station that when entirely completed and operating on a suitable load the plant will have a record of producing current at a cost of less than three-quarters of a cent per kilowatt-hour, including depreciation and interest on investment.

The power house building is built of brick and is very large, fronting 276 feet on Forty-ninth street and 214 feet on Oakley avenue. Following the usual practice, it is divided into engine and boiler rooms, with a wall of masonry between. But half of the available space in the building is utilized by the present plant, the remainder being left for extension in duplicate. The stack is square at the base and round above and is 207 feet high. It is of brick and the flue has a uniform diameter of 14 feet eight inches. A duplicate stack at the other end of the station will be built when the full capacity of the station is utilized. Between the base of the stack and the wall of the adjacent boiler room there are two railroad tracks for coal cars or cars to remove ashes, used in conjunction with the coal and ash-handling machinery. The stack is entirely distinct from the building, and the cars run underneath the connecting breeching. The coal is discharged into a hopper under the tracks and thence into the buckets of a McCaslin conveyor furnished by the John A. Mead company of New York. The buckets are driven by means of a 15 horse power engine, located between two of the batteries of boilers. The coal is carried by the conveyor to elevated tanks located above the boilers, where an automatic tripping device is arranged so that the buckets will discharge at any desired point. The empty buckets then descend and run underneath the boilers, where they receive the ashes from hoppers located under the ash-pits. They dump into an elevated ash-hopper, whence the ashes are dumped into cars.

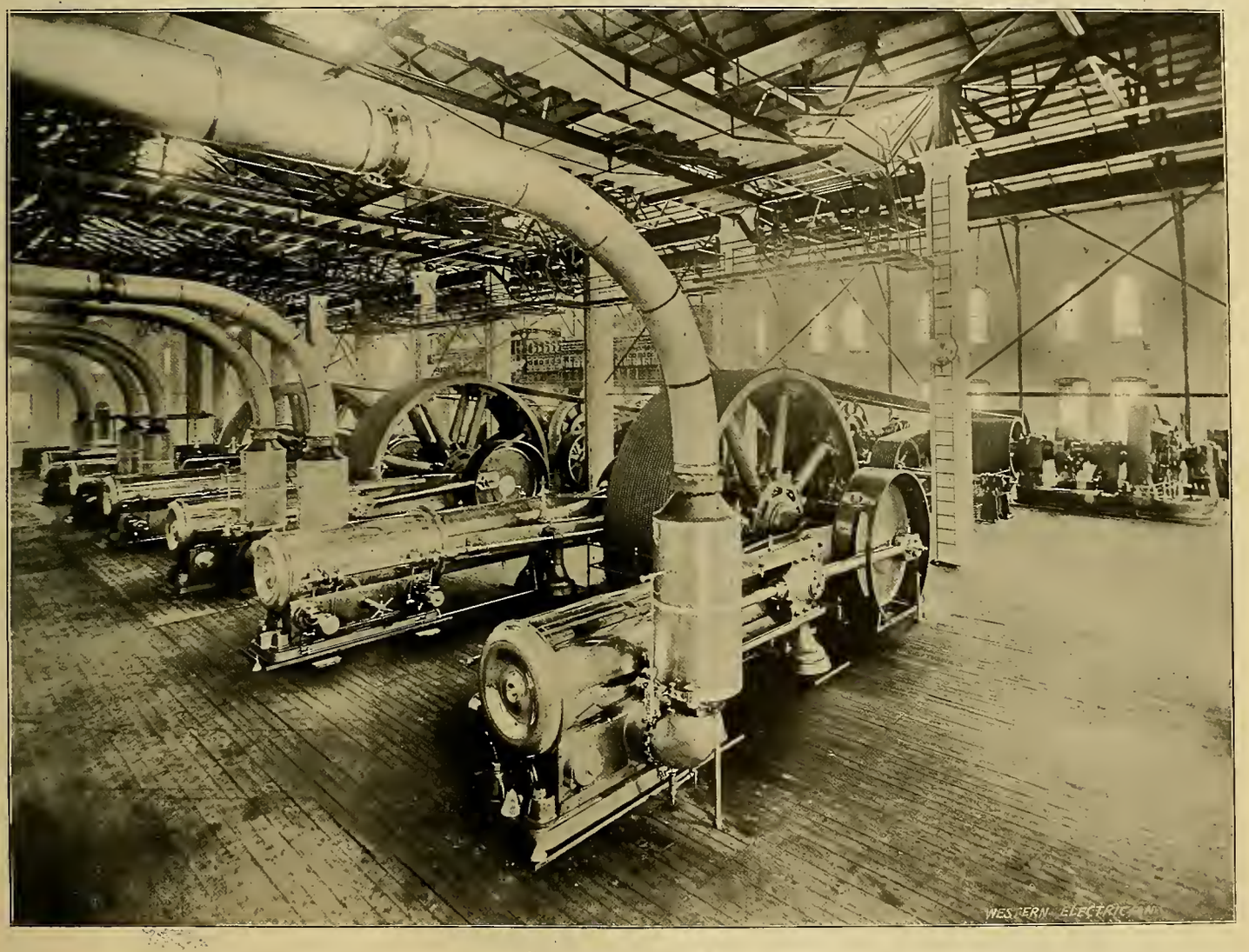


FIG. 1. CHICAGO CITY RAILWAY COMPANY'S NEW ELECTRIC POWER PLANT.—GENERAL VIEW IN ENGINE ROOM.

In the boiler room (Fig. 3), which is 270 feet long and 99 feet wide, are 24 return tubular boilers built by John Mohr & Sons of Chicago. These boilers are fitted for Murphy furnaces and are placed in batteries of six, two batteries on each side of the room. These boilers, 20 feet long and 78 inches in diameter, are built to carry a working pressure of 120 pounds of steam and are rated at about 350 horse power each. A duplex compound feed pump was furnished by Weir & Craig of Chicago, and a Green fuel economizer of exceptional size is to be installed. The steam and water piping is all of the single system, and was put in by S. J. McCloud of Chicago. The feed-water is taken directly from the city mains through a Baragwanath feed-water heater by exhaust steam injectors. The live steam headers are placed above the boilers, with which they are connected by bent copper pipes entering the headers at the side. The

pipes leading to the engines are connected at the top of the header and are of wrought iron. Passing through the dividing wall, these steam pipes bend over to the engine cylinders, as conspicuously shown in Fig. 1. Each is provided with a "Direct" steam separator. The exhaust header is in the basement. The pipe covering was supplied by the H. W. Johns Manufacturing company.

Six engines and six generators (Fig. 2) comprise the equipment of the engine room—half of the total capacity of the station, as in the case of the boilers. The engine room is 270 feet long and 110 feet wide, with a double truss roof, having a line of piers of iron and brick as the central support. The engines are arranged in three pairs, each with a common shaft and fly-wheel, driving by rope transmission a pulley on a jack-shaft supplying power to the two corresponding generators. The engines are of the Green-Wheelock type, with Hill valve gear, made by the American Wheelock Engine company, and each pair can develop from 2,000 to 2,500 horse power. These twin-pair engines are run non-condensing at a steam pressure of from 105 to 110 pounds and at 75 to 77 revolutions per minute. The cylinders are 36 inches in diameter with 60-inch stroke. The weight of each pair of engines is about 150 tons. The fly-wheel is 20 feet in diameter and weighs 70 tons. It is grooved for 30 turns of 1¾ inch Manila rope. About a mile of rope is used on each unit, the Hoadley compound wind system of rope transmission being employed, with overhead sheaves and tension carriage. In this system the rope is continuous and is carried 30 times around the fly-wheel, 12 times around a compound multiple winder situated between the engines and the driven pulley, and 42 times about the driven pulley. The compound multiple winder and driven pulley are each eight feet in diameter. The tension on the rope is maintained by passing it around a 104 inch pulley mounted on a horizontal carriage running on tracks overhead in the engine room, and with tension weights hanging in the boiler room.

The generators are of Walker make and are 800 kilowatt, 10 pole, 550 volt machines of the standard type of railway equipment. They are over-compounded 10 per cent. and are operated at a speed of 220 revolutions per minute. Each pair of generators is driven from a jack-shaft on which, between the generators, is mounted the driven pulley of the rope drive. This shaft has two Hill friction clutches, one on each side of the great pulley. Each of these clutches has 2,000 horse power capacity and is used to transmit the power from the pulley to the generator adjacent to it. Each unit of two engines, two generators and the connecting apparatus weighs about 300 tons. The foundations are of concrete with spaces giving access to all anchor bolts.

As may readily be judged by an inspection of Figs. 4 and 5, the switchboard is a large and imposing affair. It is on a balcony 108 feet long on the southern wall of the building, 15 feet above the floor, from which it is reached by circular iron stairways at each end. The board is of enameled slate, 97 feet long and 12½ feet high. It has 12 generator panels in the middle portion and 56 feeder panels, each arranged for two feeders. In addition there is, on the central panel, the main station ammeter, which reads up to 20,000 amperes, and is said to be the largest instrument of its kind in the world. It is a Weston instrument, as are all the ammeters and voltmeters on the board. This panel also carries two voltmeters, pivot mounted, while above them is a clock. Six of the generator panels have each a 2,000 ampere Thomson recording wattmeter, a 2,500 ampere ammeter, a Cutter automatic circuit breaker, two switches and a hand-wheel for controlling the field rheostat. These rheostats, or regulators, supplied by the Cutler-Hammer Manufacturing company, are mounted back of the upper part of the board on angle-iron supports. The resistance coils are open, and the rheostats are of sufficient size to run cool.

Each feeder panel is equipped with Garton lightning arresters, ammeters, circuit breakers and switches for two feeders. Eventually 112 feeders will be supplied with current in this way, although at present a load is found for but a portion of the generator capacity already installed. The back wiring of the board is well and substantially done. The great laminated bus-bars have a combined sectional area of 24,000,000 circular mils, 12,000,000 on each half of the board. The feeders, in the shape of rubber-covered cables, are led back and down from the board, as shown, to a subway in the basement (Fig. 6), whence, now lead-encased, they are taken on racks to the poles outside. As will be seen, the racks provide ample accommodation for all the feeders that will be needed for some time to come. The wire for the station was furnished by the Washburn & Moen Manufacturing company.

The equalizer switches are placed on a stand on the engine-room floor, between the middle unit and the southern wall.

The plant is now operated a portion of the day to relieve the Fifty-second street station. It is situated in a thinly settled part of the town, but in a few years will probably be surrounded by a network of electric railways, although now only one is near. And if, as seems likely, the State and Cottage Grove cable lines are electrically equipped, there will undoubtedly be a heavy demand on the new station for current for the cars on some portions of these lines.

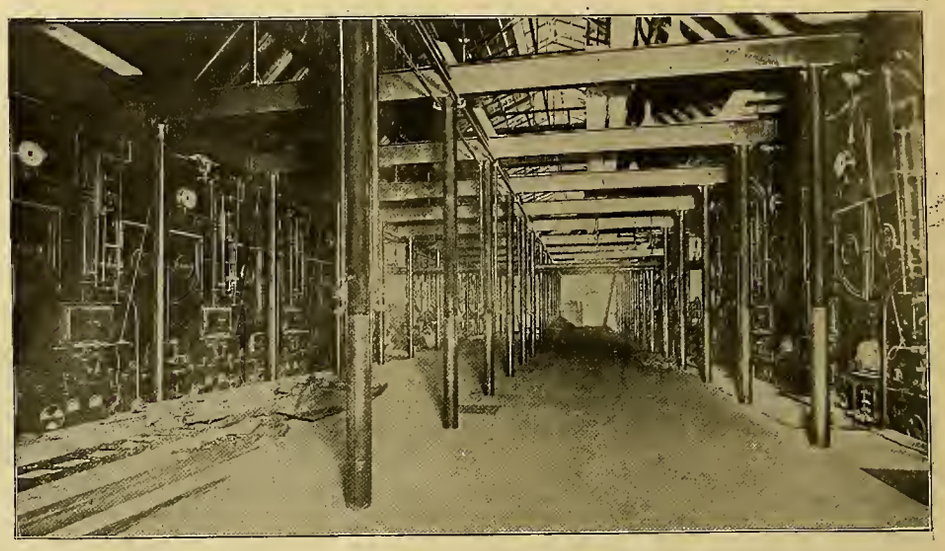


FIG 3. CHICAGO CITY RAILWAY COMPANY'S NEW ELECTRIC POWER PLANT.—BOILER ROOM.

FIG. 2. CHICAGO CITY RAILWAY COMPANY'S NEW ELECTRIC POWER PLANT.—THE GENERATORS AND ROPE DRIVE.

Chicago Street Railway Affairs.

The principal topic of conversation in street railway and political circles in Chicago during the last two weeks has been the controversy over the General Electric Railway company's ordinance. The City Council had granted the company a franchise to build an underground conduit trolley system, and there had been much litigation and discussion over the project, as the Chicago City Railway company bitterly fought the new enterprise. The validity of the ordinance was passed upon by the Supreme Court of Illinois only a few weeks ago, and the favorable decision encouraged the hope that the underground system would be given a fair trial. The owners of the franchise, however, immediately secured the passage of an ordinance granting them the right to construct an overhead trolley system instead of the underground conduit trolley which they had promised to build. At the last council meeting, on July 12th, Mayor Harrison vetoed the action of the Council at its meeting on July 6th. In his message the mayor said: "The main point at issue now is the flagrant breach, first, of a contract entered into between the General Electric company and the owners who signed frontage consents for the property along the proposed line of construction, and, secondly, of the contract entered into between said railway company and the municipality represented by the then mayor of Chicago. In this connection it is well to bear in mind that the frontage consents acquired by this company contain the following clause: This petition to be void unless the underground conduit system of propulsion is used (no poles or overhead wires in the street). It was upon this express condition, unequivocally stated, that the right to use the various streets was given by the property owners and secured by the company. This agreement has become a vital covenant of the contract, and, according to all reputable business principles, should be rigidly observed and lived up to. The proposition to withdraw from this contract, without even an effort to prove the efficiency of the underground system, smacks of shady methods to say the least, and this council, if it has the slightest regard for the interest of the city or respect for the obligations

of a contract, can do nothing else than recind its actions of last week."

Not content with vetoing the ordinance, the mayor made an active canvass of the aldermen and secured enough votes to sustain his action.

During the week charges of perjury, forgery and corruption were freely made by the present owners of the General Electric Railroad franchises and the original promoters of the enterprise. Henry Brandenburg, who

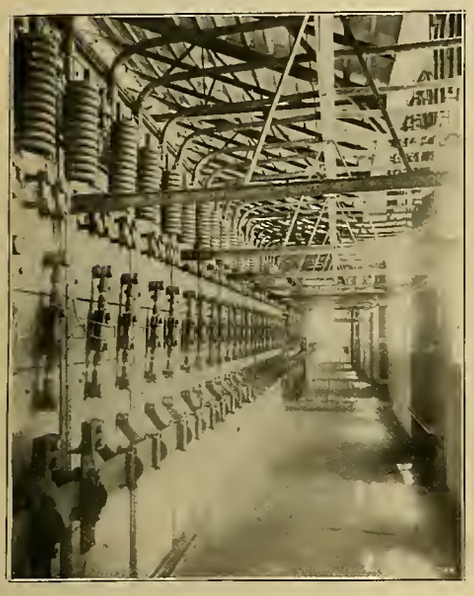


FIG. 5. CHICAGO CITY RAILWAY COMPANY'S NEW ELECTRIC POWER PLANT.—REAR VIEW OF SWITCHBOARD.

was the originator of the scheme, began an action against Lucius Clark for the recovery of stock of the road said to have been transferred without consideration by Brandenburg to Clark. The latter retaliated by beginning criminal proceedings against Brandenburg, charging forgery and perjury. In the proceedings it was developed that several prominent aldermen and city hall lobbyists were mixed up in the deal and that in the event of the case coming to trial it was promised that there would be some sensational developments as to the methods employed in securing the passage of the ordinance. On preliminary examination Brandenburg was held for the grand upon the charge of perjury. The forgery case will be considered next Monday.

The village of Wadena, Minn., voted to purchase the electric light plant.

Power Plant of the Pioneer Electric Power Company of Ogden, Utah.

In the WESTERN ELECTRICIAN of May 22d last was given a brief outline description of the exceptionally interesting power transmission plant of the Pioneer Electric Power company of Ogden, Utah. A more detailed account, with illustrations, is now at hand, and is deemed worthy of the space accorded to it:

The city of Ogden is situated in the basin of the Great Salt Lake, at an elevation of 4,300 feet above sea level, about 13 miles east of that body of water and 35 miles north of Salt Lake City. The city extends eastward to the base of the Wahsatch Mountains, which tower 5,000 feet higher, reaching a total altitude of fully 9,000 feet above sea level. This chain of mountains is intersected by numerous deep valleys or cañons, forming the outlet for drainage areas of considerable extent. The outlet of the cañon of the Ogden River is east of Ogden and distant about two miles from the business center. It is a narrow, winding gorge, walled in by high and precipitous mountains, nowhere more than a few hundred feet in width at the bottom, while at some points it is so narrow that the construction of the excellent macadamized road that traverses it involved considerable rock excavation. At a point about six miles above its mouth the narrow gorge through which the river flows widens out into a valley, some eight miles long and four miles wide, surrounded by an almost continuous mountain chain. This valley is traversed by three streams which unite at the upper end of the cañon to form the Ogden River.

The average annual rainfall in Ogden is 14 inches. In the Ogden Valley it is probably twice as great. The drainage area is about 360 square miles. The flow of the river varies greatly in different years and at different seasons. In May and June, when the snow on the mountains melts, a maximum flow of 4,800 cubic feet per second has been measured, while a minimum of 80 cubic feet in August and September is also on record. The minimum in average years is fully 125 cubic feet per second. The slope of the stream in the upper valley is comparatively gradual, while in the six miles of the cañon there is a total fall of nearly 500 feet. This portion of the river has long appeared an attractive field for the development of power, but apart from a small saw-mill near its mouth there have been only abortive attempts made at utilizing the fall of the stream.

The plans of the Pioneer Electric Power company contemplate the utilization of the waters of the entire Ogden River water-shed above the mouth of the cañon for the development of power as well as for irrigation. The central features of the plant are: A large storage reservoir and a masonry dam at the upper end of the cañon, a pipe conduit six feet in diameter, a power house with water-wheels and electric generators, electric transmission lines and sub-stations for distributing the power to different points, and an extended system of irrigation canals.

The storage reservoir will cover an area of about 2,000 acres, and will have a capacity of nearly 15,000,000,000 gallons. It will be formed by building across the cañon a short distance below its upper end, a dam of concrete masonry built up of isolated piers and arches founded on bed rock. The length of the dam on its crest will be about 400 feet It will have a total height of 100 feet, 60 feet of which will be above the level of the present river bed. The up-stream face is protected by a steel plate covering to prevent abrasion and percolation.

A nine foot tunnel excavated through the solid rock around the south abutment of the dam, forms the outlet for the water of the reservoir. At its upper end it connects to a masonry inlet tower, which is in turn connected by a riveted steel pipe eight feet six inches in diameter, with the main gate house 100 feet below the tunnel. This contains two 72 inch valves, one controlling the supply of the main conduit, the other discharging the surplus water.

The main conduit is a pipe line six feet in internal diameter. Its total length is 31,600 feet, of which 27,000 feet is wooden stave pipe and 4,600 feet at the lower end

FIG. 6. CHICAGO CITY RAILWAY COMPANY'S NEW ELECTRIC POWER PLANT.—SUBWAY FOR OUTGOING FEEDERS.

riveted steel pipe. It is laid in a trench 8½ feet wide (Fig. 1), and covered with earth to a depth of three feet on top. The selection of smooth wooden stave pipe in lieu of steel pipe throughout was made on account of the greater cheapness of the former, as well as its less internal resistance to the flow. The pipe is laid along the side of the cañon and follows the mountains to a point about half a mile beyond the mouth of the cañon. It is built to conform to a hydraulic grade line of two feet per thousand, a slope believed to correspond to the friction in the pipe. At the upper end of the pipe the inlet is funnel shaped, and the wooden pipe is continuous except at three points, where two riveted steel elbows and a short length of tunnel are substituted. There are eight tunnels in the rock, the longest being 667 feet. There are also eight steel bridges with a total length of 560 feet, beside a timber trestle. The maximum hydrostatic head in the wooden pipe is 117 feet, giving a pressure of 50 pounds per square inch.

From the end of the wooden pipe the steel conduit runs to the power house. The slope of this is quite steep and the pressure is from 50 to 200 pounds per square inch. It is 60 feet in diameter until it reaches a point 100 feet from the power house, where it divides into two branches 54 inches in diameter, which lead to two receivers, one on each side of the power house. There are 13 elbows in this pipe and its entire weight is

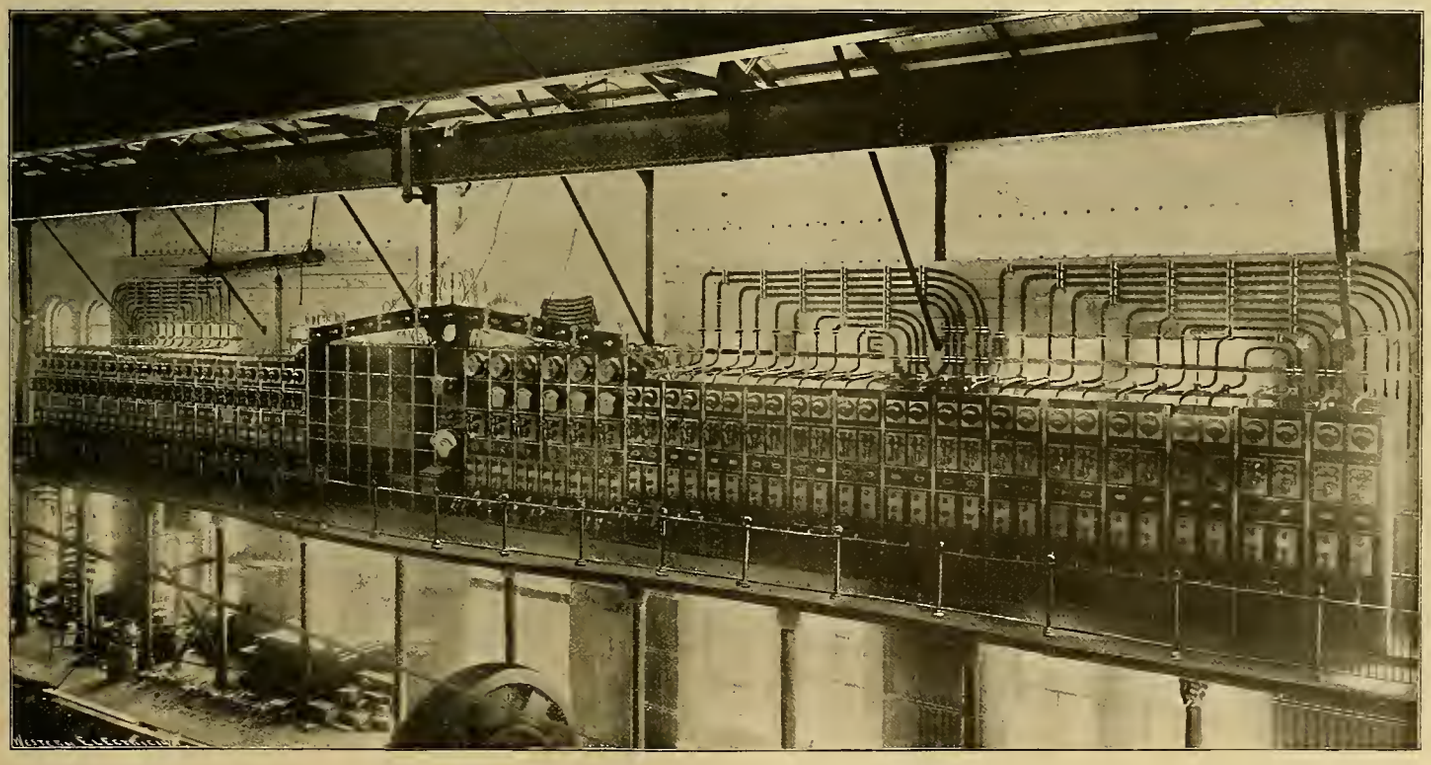


FIG. 4. CHICAGO CITY RAILWAY COMPANY'S NEW ELECTRIC POWER PLANT.—SWITCHBOARD.

over 2,500,000 pounds. The total efficient head, from the flow line of the reservoir when it is full to the center of the receiver, is 446 feet.

All the steel pipe sections were rolled and riveted at Ogden, in a shop built and equipped with machinery for that purpose. This was done in order to escape the heavy railroad charges which would have been necessary had the rolled sections been built at the works. The building was equipped with all the machinery necessary for rolling, punching, riveting and calking the pipe sections, and an air compressor by which the riveting and calking machines in the trench were driven. After about July 15, 1896, when the first plate was punched, the work was carried on night and day and seven days in the week. The steel pipe, after it had passed the riveting machines, was given a prolonged bath in asphalt.

The riveting of the pipe in the trench was effected by power riveters, operated by compressed air at a pressure of from 50 to 75 pounds. Five hundred rivets per day of 10 hours were driven by each machine. At the steep grades of the steel pipe line it is anchored by means of concrete anchorages built around it eight feet by 10 feet in section and 10 feet long.

Fig. 1. Trench in Ogden Canyon.

Fig. 3. The Pipe Line along the side of the Canyon.

POWER PLANT OF THE PIONEER ELECTRIC POWER COMPANY OF OGDEN, UTAH.

The wooden pipe is built up of Douglas fir staves tongued and grooved, 32 in circumference, 16, 18 and 20 feet lengths and two inches thick. All the staves were planed and dressed in a special mill erected near the mouth of the cañon. The pipe as shown in Fig. 2 was laid upon sills set in the trench, and was banded with round steel rods five-eighth inch and three-fourth inch in diameter, the latter being used where the pressure exceeds that due to a head of 100 feet. In order to bring the staves to the non-inaccessible parts of the cañon, a cableway 1,000 feet long, erected on framed towers, was built.

Between the inlet tower at the dam and the power houses there are five large gate valves, besides the smaller blow off and relief valves. Three are six feet in diameter, the other two 42 inches. The first two the larger ones weigh about 23,000 pounds each, and are in the gate house, the third is placed near elbow No. 2 of the steel pipe line, about 100 feet below its junction with the wooden pipe. Its purpose is to permit the closing of the wooden pipe to keep it full of water even when the steel pipe is empty. The head at this point is about 200 feet. The valve has only a single valve stem and is operated by a hydraulic lift supplied with pressure water from the main pipe above the valve. The total weight of this valve is 52,000 pounds, the heaviest single piece in it weighing about 20,000 pounds. Besides these large valves there are two smaller, each 24 inches in diameter. These are placed between the lower end of the six foot pipe and the power house in the 54 inch branches leading to the receivers. These branches are reduced to 42 inches by the use of Venturi meters, thus permitting the use of the smaller valves, which are operated by hand. The pipe is fully provided with air, mud and relief valves. The connection between the main pipe and the branches is made by a breeches casting secured to the steel pipes by cast-steel angle flanges and bolts. To withstand the great longitudinal pressure, a heavy concrete block is built around the casting. Fig. 3 gives a view of the pipe line along the side of the cañon.

FIG. 2. POWER PLANT OF THE PIONEER ELECTRIC POWER COMPANY OF OGDEN, UTAH.—MAKING THE WOODEN PIPE.

Of the nine bridges the longest is that over the Ogden River. This is a riveted bowstring girder 75 feet long. The other bridges carry the pipe line over lateral ravines or were built in place of masonry retaining walls, where a steel structure was cheaper.

The power house (Fig. 4) is built of pressed brick, with concrete and rubble footings, and cut stone trimmings. Its outside dimensions are 135 feet in length by 50 feet in width. The roof trusses are of steel, and are supported on steel posts imbedded in the brick walls A traveling crane of 15 tons capacity, operated by hand power, traverses the building, the track girders being carried by the steel posts. This building contains all the hydraulic and electric machinery used, and is completely illustrated by Figs. 5, 6 and 7. A smaller separate building serves as a machine and blacksmith shop.

The water is delivered from the pipe conduit into two receivers buried in the ground, one at either side of the power house. They are six feet in diameter, and, in their general appearance and the material used, closely resemble the regular steel pipe conduit, the thickness of the metal, however, being increased to seven-eighths inch in order to allow for the water hammer.

The receivers are provided with five safety valves each, which discharge when the pressure exceeds 200 pounds per square inch, and an outlet gate at the bottom. From each of these receivers, five 20 inch and one 10 inch intake pipes extend to the walls of the power house to connect with the water-wheel nozzle pipes. Between these intakes and the nozzle pipes are placed the following valves in the order named: One 18 inch geared gate valve, one 18 inch hydraulic gate valve, and one 18 inch butterfly valve.

The 18 inch geared gate valve is only to be used in case of repairs to the particular machines that govern it. The 18 inch hydraulic gate valve is piped up to a small D-valve, which is placed back of the switchboard and under the floor. By means of a lever on the switchboard, connected to this D-valve, the gate can be opened or closed at the operators' will. This valve is the one which is to be used for starting or stopping a wheel. The 18 inch butterfly valve is operated by means of a worm gear from the governor, and is used in checking the speed of the wheel by reducing the head or pressure near the nozzle, and thus avoiding a sudden fall of head in the main pipe line, which would be detrimental to the proper working of the plant.

The nozzle for the water wheels has six rectangular openings or pores, $1\frac{1}{16}$ by $3\frac{1}{2}$ inches in area, of which the operator is able to close one or more, as he may desire. The levers that operate the hydraulic gate and nozzle are placed near the top of the switchboard. The set of levers for each water-wheel is placed in the panel governing the generator which is driven by the wheel in question, so that the operations required in starting or stopping these machines are reduced to a minimum. The wheels are of the impulse type, directly connected to the generators. The complete plant will consist of 10 units, five being already installed. The power house and receivers being built for the 10, the balance can be readily installed at any time.

The Knight water-wheels are 59 inches in diameter, and have 45 bronze buckets cast in one solid piece; 14 of these will, when the nozzle ports are all open, receive the water at the same instant. The centers of the wheels are made of cast-steel, the buckets being pressed on these steel centers and secured with bolts. These wheels are keyed to the generator shaft. Each wheel has a capacity of 1,200 horse power at 300 revolutions per minute, and each is provided with two fly-wheels about 70 inches in diameter, each weighing about two tons.

The armature, armature shaft, two fly-wheels and one water wheel, which comprise the moving parts, weigh 15 tons. This allows a uniform speed to be maintained, notwithstanding changes of head in the main pipe or changes in the generator load. The water-wheel, fly-wheels, nozzle and the two hydraulic cylinders controlling the nozzle ports are encased in a steel housing, bolted to the machine bed-frame.

Between the two lines of machines and down through the center of the building underneath the concrete floor is the spillway into which the wheels discharge the water, and through which the water is carried back to the river from which it is taken.

FIG. 4. POWER PLANT OF THE PIONEER ELECTRIC POWER COMPANY OGDEN, UTAH.—EXTERIOR OF POWER HOUSE, SHOWING ONE VENTURI METER AND RECEIVER.

The generators used in this plant are of the General Electric company's three-phase type, with 24 poles, and at 300 revolutions per minute have an output of 750 kilowatts at 2,300 volts and a frequency of 60 cycles per second. The factory tests show that the variation in volts will be less than five per cent., with a constant speed, should the full non-inductive load be thrown off or on.

Between the machine foundations and the building foundation wall, on each side of the building, is a subway

which runs the entire length of the building and across the rear, and in this subway are carried all the necessary piping for water-wheel controllers and all the wires between the generators and the switchboards. The cable connecting each generator to its respective panel on the generator switchboard is a three-wire concentric 250,000 circular mil lead-covered cable, and the exciting wires are a two-wire concentric No. 4 B. & S. lead-covered cable.

The exciters used on this plant are General Electric six-pole 500 volt machines, and will give 100 kilowatts at 550 revolutions per minute. Each of these machines is ample for the entire exciting current that will be needed for the ten 750 kilowatt alternators, and they are each direct-connected to a 135 horse power Knight water-wheel, similar to the 1,200 horse power water-wheels previously described. These exciter water-wheels are cross-connected to each receiver so that either exciter can be operated from either receiver.

The generator switchboard consists of seven marble panels; five for the alternators, one for the exciter and

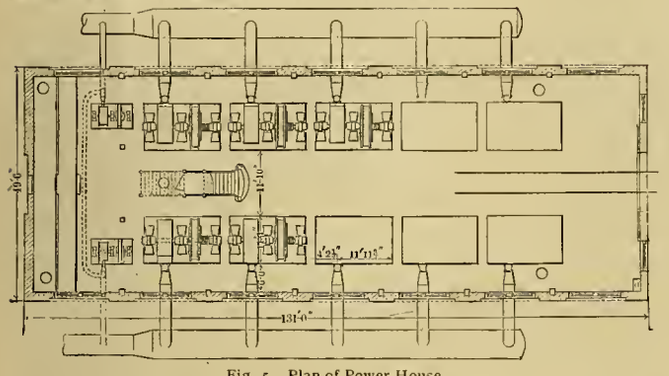


Fig. 5. Plan of Power House.

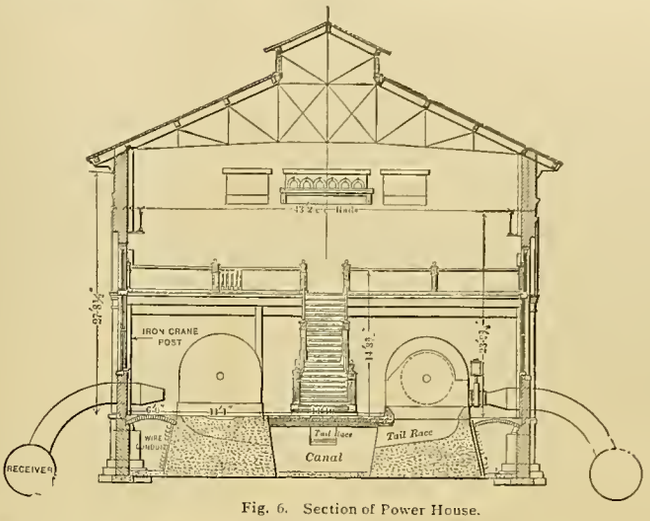


Fig. 6. Section of Power House.

POWER PLANT OF THE PIONEER ELECTRIC POWER COMPANY OF OGDEN, UTAH.

one for the instruments. These panels are 26 by 90 inches each. They are built up of blue Vermont marble, with nickel fittings. There are two sets of three-phase bus-bars on the back extending the entire length of the seven panels, as well as two bus-bars also running their entire length, from which the exciting current is taken.

From the generator switchboard the current is carried to the distributing board over copper bars, of which there are two sets of three, connecting the two sets of bus-bars on the generator board with the two sets of bus-bars on the primary panels of the distributing boards.

The distributing board is in a gallery in the rear of the building and over the generator switchboard. Back of this distributing switchboard are nine 250 kilowatt air-blast step-up transformers, the lightning arresters

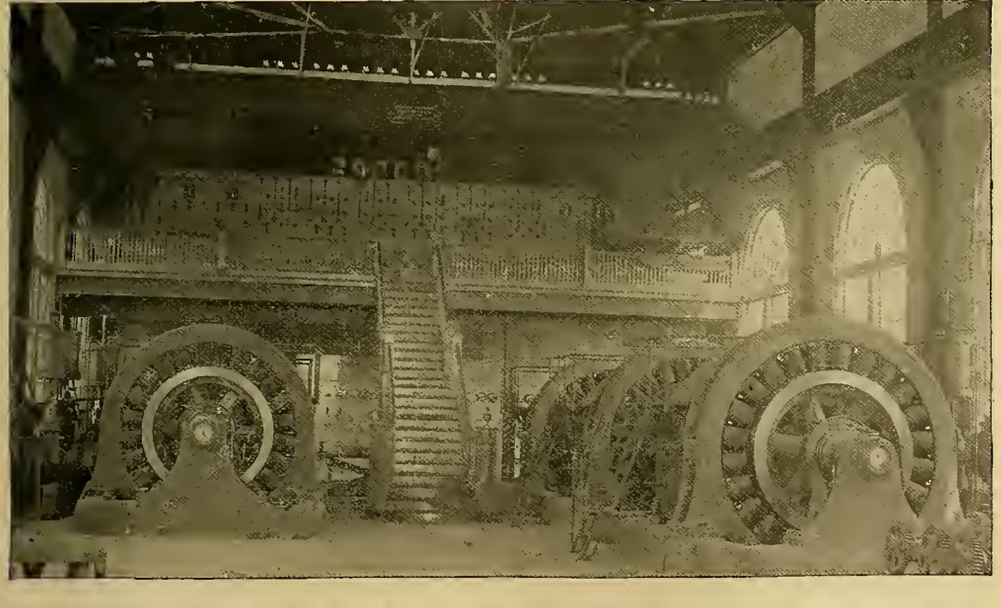


FIG. 7. POWER PLANT OF THE PIONEER ELECTRIC POWER COMPANY OF OGDEN, UTAH.—INTERIOR OF POWER HOUSE.

and the two blowers for cooling the transformers. The distributing board is divided into two sections, the primary section and the secondary section. Each section has six panels. In the primary section four of the panels are for the low-tension side of the step-up transformers, the remaining two being for the local distributing lines in the vicinity of the power plant. In the secondary section four of the panels are for the high-pressure side of the step-up transformers, and two for the long-distance transmission lines.

Back of the distributing switchboard and on a raised platform are placed the step-up transformers. These transformers raise the potential of the current from 2,300 to 16,100 volts, at which pressure it goes on to the long-distance transmission lines. The transformers are connected up in sets of three, the delta connection being used on both sides. At each end of the building in the gallery are placed the two blowers, direct-connected to a 2½ horse power 500 volt direct-current motor. These blowers are used in cooling the step-up transformers, and force the air up through the bottom of the transformers, around the coils and out at the top.

The transmission line is calculated to deliver about 3,000 horse power at the sub-station in Salt Lake City, distant about 38 miles, and consists of two circuits, making six wires of No. 1 B. & S. gauge. The poles used on this line are of Oregon cedar, and are good, clear, straight poles, 30, 40, 50 and 70 feet high, with nine and 10 inch tops. There are two cross-arms on each pole for the wire. Two wires are on the top arm four feet apart, and four wires on the bottom arm two feet apart, a circuit being on each side of the pole. These wires are so arranged that should a plane be placed perpendicular across the circuit it would show an equilateral triangle, with a wire at each angle, the length of the sides being two feet. These wires are transposed about every half mile. By this arrangement of the pole line wire the inductive effect is reduced to a minimum.

About six feet below the second cross-arm on the poles is a two-pin cross-arm, on which the telephone wires are strung, being transposed about every four poles, there being an average of about 50 poles per mile.

The current is fed into the transmission line at the power plant at 16,100 volts and delivered to the step-down transformers at 13,800 volts. This will give an energy loss of about 10 per cent. in the line and a potential loss of about 14 per cent. The sub-station step-down transformers deliver this current to the local distributing lines again at 2,300 volts. There are at present nine 250 kilowatt step-down transformers at the sub-station connected by the step-up transformers, and the switchboard in the sub-station is similar in every respect to the distributing board in the power plant gallery. The cooling apparatus here is also identical with that used in the power plant, except that the motors used are 60 cycle induction motors.

While the transmission lines are at present capable of delivering 3,000 horse power at the sub-station, with a 10 per cent. energy loss, if it should become necessary the step-up transformers can deliver more than this by changing three wires on their high-pressure side and delivering the current into the transmission lines at 27,000 volts. Thus the line capacity would be more than doubled.

The present installation of the power plant is capable of delivering 3,750 kilowatts to its lines, but ample provision has been made to increase this amount to 7,500 kilowatts by installing five more 750 kilowatt machines, as new industries or manufactories spring up as the result of the advantages offered to them in Ogden and Salt Lake City.

There is one important feature in the arrangement of the machinery which should be noticed, viz., the complete duplication of all parts. All portions of the plant below the breeches pipe casting, at the lower end of the six foot conduit, are absolutely symmetrical about the center line of the power house, each side being entirely independent of the other. This applies not only to the pipe and the receivers, but to all the parts of the switchboards, etc., as well as to the generators and water-wheels. Either one of the exciters, also, is capable of providing sufficient current for all the large generators, and can be run with water from either receiver. The advantage of this arrangement is that an accident to either receiver, or to one or more wheels or generators, would not result in the shutting down of the entire plant, but at the worst of only one side. For a short period all the required power could probably be supplied from one side of the power house.

The current will be used to drive factories, running electric railways from Ogden to Salt Lake City, to the lake, to Hot Springs and to light the towns and cities in the north of the state. The surplus water in the storage reservoir will be utilized to irrigate large tracts of land in the vicinity.

The Pioneer Electric company was organized November 27, 1893. The president and treasurer of the company is the Hon. George Q. Cannon, the intellectual and diplomatic head of the Mormon church. The general manager is Frank J. Cannon, son of the president, and United States Senator from the state of Utah. The directorate consists of Wilford Woodruff, president of the Mormon church, Joseph F. Smith, one of his counselors, F. D. Richards, one of the apostles, Asabel Woodruff and A. B. Patton, president of the Ogden Chamber of Commerce. Mr. Patton and the chief engineer and secretary, C. K. Bannister, are the only men among the directorate not members of the Mormon church.

The conception and successful completion of the works belonging to the Pioneer Electric Power company are largely due to the efforts of C. K. Bannister, M. Am. Soc. C. E., who, as chief engineer and secretary of the company, has devoted several years to the careful study of the engineering and financial problems involved. Preliminary surveys were made in 1894 and 1895, but it was not until the beginning of 1896 that the location of the plant was definitely settled and actual construction begun.

Northwestern Convention at La Crosse.

Indications promise an interesting and well attended convention of the Northwestern Electrical association at La Crosse, Wis., on Wednesday and Thursday of next week. F. A. Copeland of La Crosse has taken charge of the arrangements for hotel accommodations and for exhibits. Secretary T. R. Mercein of Milwaukee (511 Montgomery building) and George Cutter of Chicago (1106 Rookery) are the transportation agents. The latter has secured a special rate of a fare and a third for the Chicago delegates. This will not interfere with the certificate plan for other delegates, as the Chicago tickets will be counted to make up the 100 necessary. All delegates going from Chicago should communicate with Mr. Cutter at once, as he has to buy the tickets together in order to secure the rate. The train leaves the Chicago & Northwestern railway station at 10:15 P. M. on Tuesday, July 20th; a special sleeper will be attached.

The list of papers to be read was given in the WESTERN ELECTRICIAN of July 3d.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:
Suite 510 Marquette Building, CHICAGO.
TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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WITH the Niagara Falls convention number of the WESTERN ELECTRICIAN, dated June 12, 1897, this journal made a new record for itself both in circulation and advertising. Of this 100-page number 20,000 copies were printed and circulated and the amount of full paid advertising matter carried was 8,643 square inches.

The remarkable success of this journal, especially in view of the hard times that have prevailed throughout the country, is all the more striking because of the fact that it is only 10 years since the first number was issued. Its advancement has been rapid and in keeping with the progress of the great industry it represents and the splendid field which it occupies. It is a noteworthy fact, especially in view of existing conditions, that during the period of depression this journal has made steady gains in advertising. Beginning with the convention number of March 3, 1894, the record shows constant gains each year until in the present case the number of square inches of full paid advertising matter is more than double that of the 1894 number. The figures showing this unprecedented gain are given in the accompanying table:

Issue.	Number of Advertising Pages.	Whole Number of Pages.	Square Inches of Paid Advertising Matter.
March 3, 1894....	40	56	4,145
February 23, 1895.	52	68	5,593
May 9, 1896.....	72	88	7,576
June 12, 1897.....	80	100	8,643

This constantly increasing patronage speaks eloquently of the influence and merit of this journal and of the confidence and respect which it commands throughout the country. It is pleasing recognition of the efforts that have been made in the interest of the entire fraternity.

CENTRAL station managers throughout the Northwest should not fail to attend the meeting of the Northwestern Electrical association at La Crosse next week, even though they may not be members of the organization. Special efforts are being made to get a good representation from those districts that have heretofore shown little inclination to encourage the movement. During the last few months many of the companies that have been threatened by the municipal ownership movement have expressed a willingness to join the organization. While the association is always willing to receive members, an application that is prompted by fear of an attack of this kind cannot be viewed with the same favor as those that come from managers who desire to help along the work that the organization has undertaken. In the history of the association it has transpired that several companies which have refused to join the organization have afterward appealed for assistance in fighting the municipal ownership movement. Aside from this feature of the organization's work, there is much to commend it to central station men. The papers presented at the meetings are always practical, and there are always plenty of practical men on hand to discuss questions of operation and management.

SOME eastern newspaper man anxious to make "a good story" was no doubt responsible for an article published in Chicago last Sunday and attributing extraordinary designs to Mr. J. Pierpont Morgan, who proposes to equip all the railroads in the United States for electrical operation forthwith, if one may believe the account. Give heed to the magnificent details: "More than 27,000 miles of railroads come within the scope of Mr. Morgan's great plan, stretching from Boston to Portland, Ore., and in the South to Florida and Mississippi. These roads, together, represent a capitalization of $1,016,982,259. Roughly estimated, the cost of electrical equipment on this 27,367 miles of road will be $547,540,000. Practically the whole of this amount of $547,540,000 will pass through the treasury of Mr. Morgan's electrical works, leaving there in the shape of the manufacturer's profit 25 per cent., or $136,885,000. The patents for the system which will bring in this princely revenue are valued now at $8,000,000." The "electrical works" referred to are those of the General Electric company. It is explained that Mr. Morgan's friends are a little "sore" because he induced them to invest in General Electric, and that the great man has planned this coup "to lead them out with honor." The third-rail is to be used, and the system is "already planned down to the small details." There is, of course, a grain of truth amid this bombastic chaff, but it is a pity that the rational development of the work of applying electrical power on railroads in place of steam locomotives, as conditions may warrant, should serve as a pretext for such foolish exaggeration as that quoted.

IT might be considered presumptuous to pass upon the relative merits of the controversy over the Chicago General Electric Railway company's ordinance at the present time, but there are certain features that may be discussed with propriety. Principal among these is the well deserved rebuke administered by Mayor Harrison in his veto message when considering the proposition of the company to disregard the terms of its contract with the city and with property owners from whom it obtained frontage consents. The only claim the promoters of the scheme had to consideration was the agreement to build an underground conduit trolley line. Immediately upon securing the ordinance granting this permission, they announced that they had sufficient capital pledged to build the road. Later it developed that they could not raise the funds unless the ordinance was changed and provision made for the substitution of the overhead for the underground trolley system. To this the council agreed, but the mayor put an effectual check upon the proceedings, and now the promoters of the ordinance find themselves in a peculiarly embarrassing position. Briefly stated, the record of this enterprise is as follows:

First, a liberal franchise was granted for an underground conduit trolley line.

Secondly, the promoters declared that upon careful investigation they learned that such a system was impracticable in Chicago because of climatic conditions and poor drainage.

Thirdly, permission to substitute the overhead for the underground trolley system was refused.

As a result, the projectors of this enterprise find that they have a worthless franchise on their hands. They have a right to build an underground trolley road, but they themselves have publicly declared that such a road cannot be operated in Chicago, and of course they cannot now hope to interest capitalists in the original scheme, after having condemned it themselves. It is probable that very little consideration will be given the statements of the promoters of this scheme by those interested in the actual development of an underground conduit trolley system.

There are other features of this undertaking that are equally reprehensible. It was generally believed by street railway men that the ordinance was a "hoodle" measure, and this opinion is now confirmed by the disclosures that have been made during the last two weeks in the litigation growing out of the claims of ownership of a considerable portion of the stock of the company. It would seem from the disclosures already made that the enterprise has been tainted with fraud and corruption from its inception, and that disreputable methods have been employed at every step. A complete exposure of the methods and operations of the company should be made

THE excellent work done by the committee representing the National Electric Light association in the conferences which resulted in the adoption of a standard set of rules for electrical construction by the electrical, insurance and architectural interests of the country is generally recognized and commended, but it is rather unfortunate that it was deemed advisable by the committee to present a report in which a labored attempt is made to place the blame for the evils of poor construction and other faults upon the insurance interests. In the first place the report is misleading, but even if it were true in every particular, it would be far better to pass these matters and take advantage of the good feeling now displayed by the insurance interests of the country. Everyone familiar with the actual condition of affairs will acknowledge that much credit is due the National Electric Light association for the position it assumed upon this subject, and all who are interested in the matter will gladly accord that organization and its representatives great praise for their share in bringing about the present condition of affairs. But those familiar with the circumstances will recall the fact that the conditions which the National association and other organizations have been laboring for years to improve were the result of the policy adopted by the electrical interests in the early days. When the insurance companies imposed heavy penalties and trying exactions the conditions warranted them, and the electrical interests were themselves to blame for bringing about this state of affairs. There is no doubt that the underwriters resorted to extreme measures and imposed conditions that were arbitrary and in some cases, it is claimed, wholly unnecessary. But, primarily, the electrical companies were at fault, and these conditions were created by them. For a time there was a conflict between the electrical and insurance companies. The plans of the latter, it must be admitted, had little to commend them to the favor of men of experience, and in many cases the so-called electrical experts of the underwriters were not competent to discharge the duties of their positions. It will be seen, therefore, that there was ground for criticism on both sides, and a close examination of the records will disclose the fact that the electrical interests brought about much of the trouble. Now, however, there is a material change for the better, and the result of the conference will be still further to improve the relations between these interests and promote harmony. It is desirable, therefore, that this new condition should not be disturbed by a revival of the controversy and by discussion of the faults and failings of the conflicting parties in this memorable struggle. Those who have the best interest of the electrical fraternity at heart will accept the conditions of today thankfully, and work in harmony with allied interests to improve the standard of practice.

Design and Construction of Electric Power Plants.

By Bion J. Arnold, M. S.

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Part IX.—*Continued.*

Storage Battery Auxiliaries.

3. Carrying the "Peak of the Load."—Frequently a battery is called upon to take care of a load in which the variations are very rapid, but are hardly sudden enough to be called fluctuations. Such a discharge is shown by the curve in Fig. 56 and is typical of the "peak" to be found on the load diagrams of most central electric stations. The "peak of the load" generally extends over a period of from three to five hours, and during this time the generating machinery is subjected to a constantly varying demand. It is evident that if this load can be carried by a storage battery auxiliary many advantages will be gained.

The determination of the size of the battery necessary for such service as shown in Fig. 56 is obviously more a question of rate than of capacity. The actual discharge, as given by the area of the curve, is 112 kilowatt-hours. The normal discharge rate of a battery of this size is 112÷8, or 14 kilowatts. It is evident, then, that for nearly 2½ hours during the four-hour discharge such a battery would be discharging at a rate greater than the normal. The decrease in useful capacity, due to these excessive discharge rates, will make it necessary, therefore, to provide a battery of a larger size than one which would have the capacity at a normal rate determined by the area of the curve. But the question is, how much larger? A quick solution which will be found accurate enough for all practical purposes is to take a rectangle *1DE3* (Fig. 56) of the same area as the curve *oACB4* and having its long dimension *2C* equal to the maximum discharge required. Such a rectangle will give the capacity of the battery and also the discharge rate at a glance. Thus, to carry the load shown in Fig. 56, the

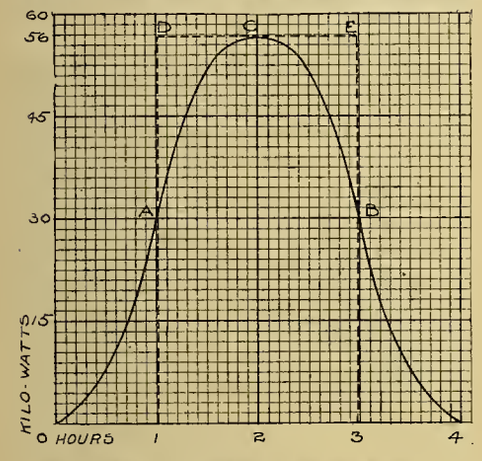


FIG. 56. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—METHOD OF DETERMINING CAPACITY OF BATTERY.

rectangle indicates a battery having a useful capacity of 112 kilowatt-hours and a two-hour discharge rate.

The size of a battery, determined by this method, will be slightly larger than that really required. It will be seen that the areas *oA1* and *3B4* are the same as the areas *ADC* and *BCE*, but that the capacity of a battery to handle a load represented by the former area is much less than that required to handle a discharge represented by the latter, on account of the evident difference in discharge rates in the two cases. Thus, while the battery is working on those parts of the load *oA* and *B4*, at no time is it discharging at a rate as high as a four-hour rate, while if it were called upon to discharge at a rate indicated by the line *DCE*, the battery would be working continuously at a two-hour rate. As the peak approaches nearer a rectangle in shape—that is, as the top of the curve flattens out—this method will approach more nearly to giving the exact size, but with ordinary cases it will approximate within 10 per cent. of the required capacity. As some allowance must always be made for an increased load, the extra capacity which a battery determined by this method will have will, as a rule, be found useful, and the method is therefore correct enough for ordinary calculations.

A typical load diagram, having a "peak," is shown in Fig. 57. In this particular case the maximum demand occurs between the hours of 5 and 7 P. M., when the output of the plant is nearly double that occurring at any other time during the day. This load comes on very suddenly and drops off even more rapidly, and is one of the chief factors in raising the cost per unit of output in an electric plant above the cost of developing a unit output of the same size in any other kind of a power station. It will also be noticed that the demand during the hours between 1 and 7 A. M. is very small in comparison to the load during the remainder of the day.

A consideration of the variations in the load diagram is important when it comes to the selection of the size of the units required. The economy of keeping the units in service loaded as nearly as possible to their full rated capacity has already been pointed out. Bearing in mind this fact, and also the necessity of providing sufficient machinery that the shutting down of any one unit will not cripple the plant, it will be seen that the load shown in Fig. 57 can be conveniently handled by four units of 500 kilowatts and two of 250 kilowatts output. Between 7 A. M. and 9 P. M. it will be necessary to operate two 500 kilowatt units continuously, and between 5 P. M. and 7 P. M. two more of the same-sized units will be required. At 9 P. M. one 500 kilowatt unit can be put out of service and replaced by one of 250 kilowatts output; at 1 A. M. the other 500 kilowatt unit can be shut down,

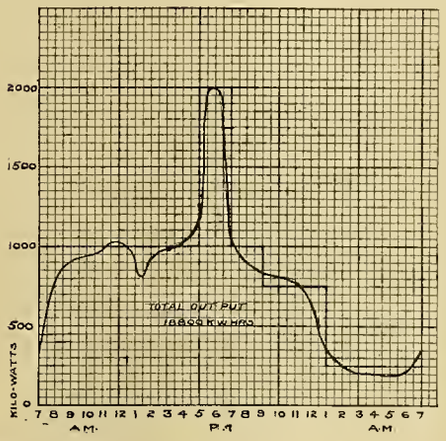


FIG. 57. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—LOAD DIAGRAM WITHOUT BATTERY.

leaving the night load to be handled by a 250 kilowatt unit. By following the load diagram in this manner the steam consumption per delivered kilowatt-hour can be kept within reasonable limits, although at times the station will be unavoidably working at very poor efficiency.

It will be seen that nearly one-half the machinery in the plant is inoperative during 22 hours of the day. Thus the earning capacity of that much of the plant is greatly reduced, while at the same time the interest on the investment and the fixed charges against this portion of the plant remain the same as if it were operating continuously for 24 hours each day. The ratio of the average output of the plant for a given time to its maximum possible output if worked continuously day and night is known as the "load factor" of the plant. It is obvious that the nearer this load factor approaches 100 per cent. the better are the conditions for low cost of production, and it is in the direction of "evening up the load line," and thus increasing the load factor, that storage battery auxiliaries often show great advantages. The application of a battery for this purpose is shown in Fig. 58. The same load diagram as shown in Fig. 57 is taken, and the load is divided between generating plant and accumulator auxiliary in such a way that the result is a steady load upon the generators during the entire time of operation. That part of the diagram shaded with lines inclining toward the right represents the charge of the battery, and that portion shaded with lines inclining to the left indicates the discharge of the battery. The battery thus carries the excessive load between the hours of 5 and 7 P. M. and also supplies the demand during the hours of light load in the early morning. Without batteries the total output found by integrating the area under the curve is 18,800 kilowatt-hours. What will be the total output if an accumulator auxiliary is installed, taking into account the efficiency of the battery?

It will be seen that the charge beginning at 7 A. M.

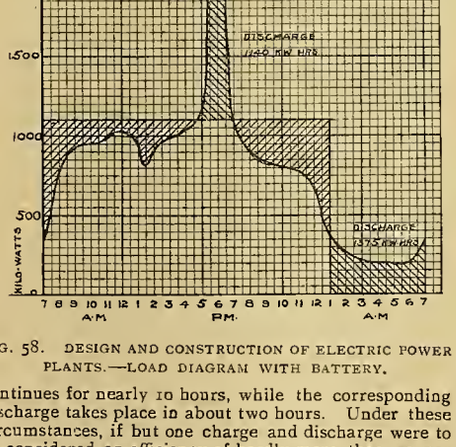


FIG. 58. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—LOAD DIAGRAM WITH BATTERY.

continues for nearly 10 hours, while the corresponding discharge takes place in about two hours. Under these circumstances, if but one charge and discharge were to be considered an efficiency of hardly more than 50 per cent. could be expected, as the amount of energy which can be recovered from a battery discharging at the above rate is only about 60 per cent. of the amount which the battery would deliver at a normal rate. But the fact remains that although the capacity of the battery is decreased by excessive rates of discharge, this decrease is due to polarization, and the battery does not really become completely discharged. Therefore, upon starting to recharge the battery it will be found to contain a certain amount of energy, for which, in regular work, it should have credit. For our purpose, then, it will be fair to assume that the efficiency of the battery will be 65 per cent. for the first discharge and 75 per cent. for the second discharge, the latter occurring in six hours, and therefore under more favorable conditions than the first. The discharge during the peak is seen to be 1,140 kilowatt-hours. At our estimate of 65 per cent. efficiency it will require a charge of 1,753 kilowatt-hours to provide for this discharge, and there will therefore be lost in the battery 613 kilowatt-hours. Similarly, allowing an efficiency of 75 per cent. for the discharge of the battery on low load, we find it will require a charge of 458 kilowatt-hours in excess of this discharge, making a total of 613+458, or 1,071 kilowatt-hours, which represents the excess of electrical energy which must be produced on account of the losses in the battery. This looks like a considerable loss to be charged up against the use of the battery, but in reality it means that the total output of the plant is increased from 18,800 kilowatt-hours to only 19,871 kilowatt-hours, or the loss due to the battery is only five per cent. of the entire electrical energy generated. Generators carrying a steady load of 1,104 kilowatts continuously for 18 hours will supply the required output. Let us see what benefits are to be gained by installing a battery under such conditions.

In the first place, the original investment in power station equipment will be less with the battery auxiliary. Without batteries there will be required four 500 kilowatt units and two 250 kilowatt units, as already shown, making a total of 2,500 kilowatts. The cost of a modern compound condensing electric station complete

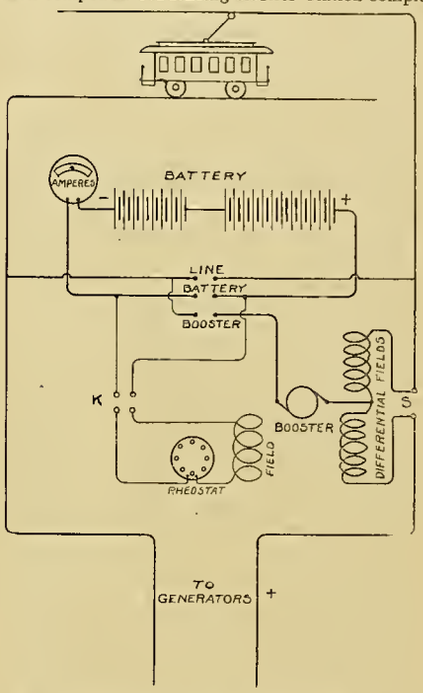


FIG. 59. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—DIAGRAM SHOWING CONNECTIONS FOR DIFFERENTIAL BOOSTER.

of this size may be estimated at $110 per kilowatt, which corresponds to about $75 per indicated horse power. Thus the cost of the plant without batteries will be 2,500×$110, or $275,000. On the other hand, the steady load of 1,100 kilowatts, which is the result of the use of batteries, can be handled easily by four 250 kilowatt units, and if one is held in reserve the investment in generating machinery becomes 1,250 kilowatts at $110 or $137,500. To obtain the cost of the battery it will be necessary to determine its capacity by the method already given in Fig. 56. Thus, a battery having a capacity of 1,140 kilowatt-hours at a discharge rate of 1½ hours will be amply large. The cost per kilowatt-hour at this rate is seen from the curve of Fig. 52 (given last week) to be $90. The investment in the battery part of the plant will therefore become 1,140×$90 or $102,600, making the total investment in the second case of $137,500+$102,600 or $240,100. Thus in first investment alone the combination of generating plant and battery auxiliary will effect a saving of nearly $35,000. This saving would be sufficient to justify the use of batteries in this particular case, but even if the investment had proven to be the same in both cases the battery plan has many other advantages which would make its use advisable. The number of attendants will be less with the battery arrangement, not only on account of the actual running time of the plant being shortened some six hours, but also because there are a constant number of machines in operation all the time and there is no necessity of throwing in and out units, as was seen to be the case in Fig. 56. The objection might be urged that the battery would require an excessive amount of attention, which would tend to even up the labor account, but in actual practice an accumulator plant is found to require a remarkably small amount of attention. The attention it does receive must be intelligent, however, and the attendant must understand the conditions under which th

battery works successfuly; if this is the case the amount of time which must be devoted to an accumulator to keep it in first-class condition will be found to be much less than that required by a generating set of the same output. It would not be far out of the way to estimate that the labor account in the plant containing batteries which is here cited will be at least $1,500 a year less than with the other plan. This $1,500, capitalized at six per cent., is the same as an additional saving in first investment of $25,000.

In regard to the fuel economy, the records of many stations operating in connection with batteries show a considerable saving which can be traced to their use. This added economy is due to the fact that the units may be operating at full rated capacity while in service. In Fig. 56 it will be noticed that although an effort was made to change the number of units as the load varied, there were comparatively few times when they were working exactly at their rated output. The result would very naturally be a fuel economy much less than would be possible to obtain if the engines and generators were running steadily at their most economical output. With this in mind, it is fair to assume that the better running conditions obtained by the use of the battery will probably effect a saving in fuel greater than necessary to generate the amount of energy lost in the storage battery, and the net result will be less coal required for the total output than when the station is running without an accumulator. Another point which will have a marked influence on the consumption of fuel is the necessity in the first case of generating steam in a large part of the boiler plant for only a few hours each day. The losses in getting the boilers up to pressure, in holding them in readiness for some little time, in working them partly loaded while they are in operation, and in the unavoidable radiation losses while they are standing idle, will in themselves be more than enough to counterbalance any loss of energy due to the use of the batteries. In throwing in the units required for the peak of the load it will generally be found desirable to keep them turning over slowly for a short time before they are needed, as the exact time when the demand suddenly begins to increase cannot be predicted. In fact, the necessity of holding sufficient engine and boiler capacity in readiness to be used in case of emergency, such as the breaking down of any of the machinery in operation or the sudden approach of darkness, cannot fail to be the source of a constant loss, which seems almost unavoidable unless a battery is installed. With a battery in the power station uninterrupted service under the most trying conditions becomes almost a certainty, and this one point alone would in certain cases justify the investment, even if there were no other advantages.

It is the fact that no general law can be laid down to apply to the question, Shall a battery auxiliary be installed? Obviously, the conditions in each case will influence a decision. In deliberating upon a proposed installation it must be remembered that it is not sufficient to consider only first cost; economy in operation has an important bearing, and due allowance must also be made for the comparative importance of such items as convenience and reliability. However, in comparing the first cost of a storage battery to that of a generating plant to do the same work, the fact that the cost of storage batteries is given upon a different basis than the cost of engines and dynamos must not be lost sight of. A storage battery discharging at the normal rate can be installed for $50 per kilowatt-hour. To get a battery at this price, however, which will discharge at the rate of say 10 kilowatts per hour, or one which can be compared to a dynamo of 10 kilowatts capacity, it is necessary to install an accumulator having an actual capacity of 80 kilowatt-hours at the normal rate, which will bring the investment up to 80×$50 or $4,000. The cost of the battery, then, per kilowatt rate of discharge is seen to be $4,000÷10, or $400, and this is the figure which should be compared to the cost of machinery for providing the same service. That is, the figure which represents the cost of the battery to be compared to the cost of a generating plant of the same output can be obtained by multiplying the capacity in kilowatt-hours into the price per kilowatt-hour at the given rate of discharge and dividing by the rate in kilowatts. As the capacity divided by the discharge rate in kilowatts gives length of discharge or rate in hours, it will only be necessary to multiply the price per kilowatt-hour at any given rate by the rate itself to get the price per kilowatt output to be compared to the cost of an independent plant. Thus, the cost per kilowatt discharge at a one-hour rate is $100, at a three-hour rate is $200, at a five-hour rate $287 and at an eight-hour rate $400.

It will be seen, then, that if the method shown in Fig. 52 for determining the size of a battery to handle a peak requires a battery discharging over a period of time longer than three hours, it will probably be cheaper in first cost to install sufficient additional generating machinery to carry the peak; but for peaks which can be handled by a battery discharging in a shorter period than three hours, the battery auxiliary will probably show advantages. It is to be understood, however, that this conclusion applies only to batteries used for the sole purpose of carrying the peak of the load. If the battery is used for other purposes, such as handling the night load, etc., the other considerations of economy in operation, reduction of labor account, convenience, etc., have a much more important bearing, and the question is not so much one of first cost.

Maintenance.—It will be noticed that in the figures already given no allowance has been made for depreciation in the case of either the generating machinery or the battery auxiliary. This assumes, then, that the percentage to be allowed for depreciation is the same in both cases, and under conditions prevailing at present this may be considered true. Manufacturers of batteries are willing to take contracts to maintain the plants which they install in central stations at from six to eight per cent. per annum on their original cost, the amount depending upon the service to which the battery is subjected. The fact that in a number of cases the purchasers have found it to their interest to cancel the maintenance contracts rather than allow the battery company the profit which would result if they were carried out seems to indicate that the depreciation upon the battery part of the plant may safely be taken at as low an estimate as is usually allowed for the best steam and electrical machinery.

Storage Battery Sub-stations.—The manufacture of accumulators upon a large commercial scale has made possible the use of battery sub-stations located at points some distance from the central power station. The use of these sub-stations in certain localities, under certain conditions of service, will show a number of advantages.

In a residence district, for instance, where a central station would not be tolerated and which is removed from the main generating plant such a distance as to make prohibitive the investment in feeder mains for carrying the peak of the load, a battery may be advantageously installed. This battery will be charged during periods of light load upon the central station at a slow rate and thus acts as a reservoir, which not only cuts down the required investment in copper otherwise required, but also tends to better the economy of the main power plant by evening up its load line. It thus becomes possible to use part of the central station equipment which would otherwise lie idle during the day, and thus the total investment in generating machinery which would be necessary without a storage battery auxiliary is materially reduced. Before the installation of a battery substation is decided upon in any particular case careful figures should be made covering all the conditions. As a rule the battery sub-station will effect a saving in fuel, cut down materially the labor account and require a less investment in real estate, buildings, feeder system and power-station equipment. The question is, Will the saving effected justify the expense of installation and operation of a storage battery? In some cases, if it is found from calculation for economy only that the battery auxiliary will not pay, the increased reliability of the service may warrant its adoption.

In the operation of electric railways, and especially upon long-distance lines, storage battery sub-stations will show a saving not only in the first cost of installation but also in the economy of operation. As the cost of the feeder system varies as the square of the distance, so, as the line extends away from the power station, a point is soon reached with the ordinary standard voltage generally adopted where the cost of the feeders justifies an investment in a storage battery sub-station. This sub-station battery will act as an equalizer, receiving the average amount of energy required at a constant load, and therefore over a comparatively small feeder, and delivering the current to sections of the line upon both sides of the station as required by the varying demand.

If the electric line becomes so long that transmission by direct current is undesirable, advantages can be shown for a system having sections of the road operated by sub-stations, the equipment of these sub-stations consisting of a rotary transformer, the alternating side of which is a tie line extending back to the central station. The direct current end of the rotary transformer works upon the lines in parallel with a storage battery auxiliary, which serves the usual purpose of an equalizer.

Differential Booster.—In all cases where a battery is used in connection with a fluctuating load, and it is thought desirable to maintain a practically constant voltage upon the line and at the same time a constant load upon the generator, the use of a differentially wound booster becomes desirable. By its use it is possible to adjust the charging current so that its total for a given period of time is equal to the amount of current discharged plus the amount of energy lost in the battery, thus carrying a practically average load on the dynamo.

The necessary connections of a differential booster arrangement are shown diagrammatically in Fig. 59 (p. 35). The series field coils of the booster are wound in two sections, so arranged that the windings oppose each other. Taking the instance of the one car shown in the diagram, when there is no energy passing out on the line all the current generated at the power station passes through the lower coils of the booster fields shown upon the right-hand side, then through the booster armature, where it is raised in voltage, and thence into the battery. If there is a small demand upon the line the amount of current required to supply it will pass through both series fields of the booster, and as the windings are opposed the electromotive force of the booster will be reduced and the current charging the battery will become less in proportion as the current passing out over the line becomes greater. At a certain point no current whatever will pass into the battery, the entire output of the generators passing through both windings of the booster fields and out onto the line. If the demand continues beyond this point there will be more current passing through the upper windings, and the effect of these coils will overcome the effect of the other winding, reversing the electromotive force of the booster, which will then be added to that of the battery and assist the discharge, having the same effect as adding cells, so that the battery practically carries all of the extra load.

Advantages Summarized.—To recapitulate, the advantages which may be expected from the installation of a storage battery auxiliary in connection with a central electric power station have been shown to be as follows:

First—The entire load can be carried by the battery during periods of light demand, allowing the generating machinery to be entirely shut down.

Second—The battery will act as a reservoir in connection with a fluctuating load, taking energy when the load is less than the average, delivering it when the demand is excessive, and thus transform a very uneconomical load on a large generating unit to an economical load upon a much smaller unit.

Third—The excessive demand during the peak of the load can often be furnished by a battery with a much smaller original investment in the plant and with better fuel economy than without its use.

Fourth—An accumulator will enable the entire plant to be operated at all times at its highest economy, as it furnishes a means by which the units can always be loaded to their full rated capacity.

Fifth—A battery furnishes a reserve power which insures reliability of operation, preventing a complete shut-down in case the plant is temporarily crippled and insuring satisfactory service at times of sudden demand.

Sixth—The equipment of sub-stations with batteries will often make possible the addition of a paying load to the power station, which otherwise the cost of feeders would prohibit.

["Preliminary Determinations" are considered in the next lecture, the tenth in the series.]

Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

The new telephone line from Kingston to Dassel, Minn., is completed and in order.

The Black Hills Bell Telephone company at Rapid City, S. D., has reduced rates to $1.50 for local service per month and $2 per month for service covering the Hills. The reduction is made to meet competition of the Harrison Telephone company.

The Union Electric Telephone company has completed its line from Zumbrota to Red Wing, Minn.

The Northern Wisconsin Telephone company of Gillett, Wis., has made an assignment to its secretary, R. A. Mineily. The company has been building a line through the northern part of the state and it was the plan to build into Green Bay this summer.

The Northwestern Telephone Exchange company will have connection with Mapleton, Minn., in about a month.

The Moravia Land & Investment company has completed a telephone line between Moravia and Iconium, Iowa.

The Martin Telephone company has connected with Ellsworth, Iowa.

There is talk of building a telephone line from Necedah to New Lisbon, Wis.

J. E. Keelyn says that a telephone company, to be known as the Wisconsin Valley Telephone company, will be formed, with headquarters at Eau Claire, Wis., to build to connect with Minneapolis, Duluth, Marquette, Mich., Wausau, Merrillan, Madison, La Crosse and Red Wing. A company will also be formed to put in a local exchange in Eau Claire.

The independent telephone companies of Iowa, Nebraska and South Dakota are arranging for the consolidation of all into one company, to be known as the Iowa Telephone association.

The Dakota Central Telephone company will install a telephone exchange in Waubay, S. D., at once.

The Interstate Telephone & Electric company has been incorporated at Dubuque, Iowa, with $100,000 capital. F. F. Sapp of Chicago is president and E. T. Keim, also of Chicago, secretary. R. W. Stewart of Dubuque is attorney. Its purpose is to construct toll lines to connect with the Dubuque Telephone company.

There is a scheme on foot at Glencoe, Minn., to connect by telephone with all the towns in the county.

The Werner & Dwelle Telephone company of Lake City, Minn., will extend a line to Zumbro Falls and from Mazeppa to Hammond.

A company of Walker, Minn., business men proposes to construct a telephone line from Walker Bermidji, via Graceland.

Telephone Cranks.

The telephone mania is among the latest negative results of modern inventions, asserts a daily paper, and those who are its victims are objects of dread to their fellow-citizens, although they themselves frequently live in blissful ignorance of their affliction.

The telephone maniacs are usually men of leisure who have small appreciation of the value of time, and the more leisure they have the less hope there is for them, as far as cure is concerned. Occasionally one may see a busy telephone maniac, but the instances are rare, and in those cases the malady is not fully developed, and the chances for ultimate recovery are many. Among women there seems to be a few real cases. An unmistakable symptom of the disease is a desire to talk to people at

distant points about all sorts of things at all hours of the day or night.

"I am the prey of several of those incurable maniacs," said a busy man, whose office is visited by hundreds of people daily, "and at times they make life a burden, but I see no way to cure them or to escape their tortures. One of them calls me up at my home just about breakfast time about three mornings every week and asks me such important questions as, 'Wasn't it a fine day yesterday?' or 'Did you ever see such disagreeable weather as we are having?' or 'Do you think this will be a good day for wheeling?' or 'Will you go downtown early?' or 'How did you like the play last night?' When he wants to give an air of business to his talk he asks my opinion about the stock market, of which I know absolutely nothing, or he asks will I be sure to attend a directors' meeting which he knows I would not miss if I had to go without my dinner. All the time my coffee is getting cold, my family grows impatient, and my temper is ready to assert itself. When I reach my office an hour or two later the boy tells me that several persons have called me on the telephone, and I know by the names what their messages would have been and what they will be when they call again."

The experience of this busy man is like that of hundreds, and to avoid the senseless chatter and constant "helloing" of the maniacs, many busy men keep their names out of the telephone directory and refuse to answer calls when their numbers become known. The worst feature about the disease is that those who have it never realize that they are making themselves obnoxious, and, regardless of the hour or the pressure of business, they insist on telling long stories over the wire.

"When a man tells you a story face to face," said Horace C. Du Val, who is frequently annoyed by the telephone maniac, "he can see by the expression on your face, if he has the least knowledge of physiognomy, how the story strikes you, and it is an easy matter to cut a man off by a look or a gesture. But where are you when the story teller is 10 miles away? He has you cornered and you must listen. There is method in the madness of some of the telephone cranks, especially those who call up this office. A man will come here and wait for an hour to ask a favor. At the last moment his courage fails him; he remembers that he has an engagement elsewhere, and rushes downstairs, but presently he will call us up on the telephone and ask from a distance what he was afraid to ask at short range. Men hate to be 'turned down,' and take it with better grace over a wire.

"But we have other telephone maniacs, who think it the proper thing to call Mr. Depew every time they see anything about him in the newspapers, and tell him what a 'fine letter he wrote' or 'what a lovely speech he made,' or ask if this or that report is true; and all this from people who, if they came to his office, would probably never say more than 'Good morning.' There are cases every week when people go still further, and only a few days ago a telephone caller wanted to know from Mr. Depew if there was any doubt about getting a 'lower' for Buffalo that evening. It would be a difficult matter to get along in a large city office without a telephone, but we often feel like dispensing with it, if only to avoid the telephone crank."

American Institute of Electrical Engineers.

As already announced the fourteenth general meeting of the American Institute of Electrical Engineers will be held at Greenacre-on-the-Piscataqua, Eliot, Me., on July 26th, 27th and 28th. The following papers will be presented during the meeting:

"The Precision of Electrical Engineering." Inaugural address, by the president, Dr. Francis B. Crocker of New York.

"The Alternating Current Induction Motor," by Charles Proteus Steinmetz of Schenectady, N. Y.

"A New Form of Induction Coil," by Prof. Elihu Thomson of Lynn, Mass.

"Effect of Heat Upon Insulating Materials," by Putnam A. Bates and Walter C. Barnes of New York.

"The Effect of Armature Inductance upon the Electromotive Force Curves of an Alternator," by Prof. W. E. Goldsborough of Lafayette, Ind.

"Electric Metering from the Station Standpoint," by Caryl D. Haskins of Boston, Mass.

"Development of the Fire Alarm Telegraph," by Adam Bosch of Newark, N. J.

"Electrical Traction: Notes on the Application of Electrical Motive Power to Railway Service, with Illustrations from the Practice of the Metropolitan Elevated Road of Chicago," by M. H. Gerry, Jr., of Chicago.

"The Cost of Steam Power," by Horatio A. Foster of Buffalo, N. Y.

"Efficiency and Life of Carbons in Enclosed Arc Lamps," by W. H. Freedman of New York.

"Armature Reactions in a Rotary Transformer," by Prof. Robert B. Owens of Lincoln, Neb.

"Recent Application of Storage Batteries to Electric Railways," by Herbert Lloyd of Philadelphia.

"The Economy and Utility of Electrical Cooking Apparatus," by Prof. J. P. Jackson of State College, Pa.

Greenacre is a quiet summer resort in the town of Eliot, Maine, on the Piscataqua River, about four miles above Portsmouth, N. H., and may be most conveniently reached by steam launch leaving Portsmouth at 11:25 A. M., shortly after the arrival of the 9 A. M. express from Boston on the Boston & Maine Railroad. The single fare from Boston is $1.60 and the excursion by launch is 40 cents. No special arrangements for transportation have been made.

A less direct route, but one which offers the attraction of a short sea voyage, is that of the Maine Steamship company, whose steamers leave New York for Portland every week day at 5 P. M. The running time to Portland, which is 40 miles from Portsmouth is 20 to 24 hours. The fare is $5, excursion $8, rooms $2 to $5, meals 75 cents, fare from Portland to Portsmouth $1.50. Staterooms must be secured at least one week in advance.

Members will be provided with rooms at cottages on the grounds, or dwellings in the vicinity, or if they prefer, may secure tents in the Sunset Camp, price $1.50 per day, or $8 per week, with meals at the Greenacre Inn. Members may also secure rooms upon application to the secretary, at the Rockingham, Portsmouth, N. H., $4 per day, or the Wentworth at New Castle, N. H., $4 50 per day, American plan. Either of these hotels is accessible by steam launch from Greenacre. Ladies may be invited to the meeting.

Booklets, giving further information, will be mailed by the secretary upon application to those who wish to learn additional details before perfecting their plans.

The sessions will be held at Eirenion Hall on the grounds. There will be a reception Tuesday evening, July 27th. On Thursday, the 29th, there will be an excursion to the Isles of Shoals.

Insurance and Electrical Interests.[1]

At the seventeenth convention of this association, held in New York, a committee to be known as a committee on standard electric rules, consisting of five members, was appointed, with instructions to select one of its members or some other person to represent the National Electric Light association in the National Conference on Standard Electric Rules. This committee has labored faithfully since its organization to bring about the establishment of a uniform standard set of electrical rules governing electrical installations to be enforced by the fire insurance companies and municipal inspection bureaus. Its efforts met with fierce opposition from some and indifference on the part of others. It received some encouragement from the press at times, and no small amount of opposition at others. Some portions of the insurance interests looked upon it with favor, but a large portion opposed its aims and purposes. The principal obstacles to be overcome were, first, indifference on the part of those most deeply interested—those engaged in the electrical industries—and, secondly, the prejudice of the average underwriter against electricity when introduced into the property he insured. To all who witnessed the methods adopted by those who installed the first electric light and know something of the losses sustained by the insurers and insured, this prejudice is excusable. Up to that time electricity had proved itself a useful and harmless servant—the only evidence of its ability to produce heat or flame was offered at the contact points of the telegraph relay and key—but when this very small spark was increased at the carbon points to such size and intensity as to rival in brilliancy the sun's rays, its power for good and evil was wonderfully increased. Those who could keep under perfect control the feeble battery current did not possess the necessary appliances or knowledge to keep this new form of electrical energy under proper restraint, while the fire underwriters paid heavy tribute to it in the form of burnt offerings and in the shape of indemnity to the policyholders.

Under such circumstances, who could blame these powerful bodies for taking alarm and looking upon the new candidate for public approval with disfavor? They were between two fires, as it were, those caused by electricity improperly harnessed, and that of enthusiastic admiration kindled in the breasts of their policy-holders for the electric light, who would have it even if it did increase the fire hazard. How to get out of this dilemma was the question. Two remedies were tried: First, an increased insurance rate was the penalty exacted for the introduction of electric lights. This plan proved ineffectual, because it did not prevent losses in excess of premium rates, and it opened up a new field for the illegitimate underwriter, who preys on the insurer and insured alike in the end. The second remedy proved more effective. The underwriters called to their aid some of those who were supposed to know how to lead this new and unknown force along the straight and narrow path designed for it and not permit it to wander into their domain and chaoge fat dividends to heavy assessments. Such men were scarce, and most, if not all, of those engaged were obliged to learn by experience the best methods of procedure; the same can be said of those engaged in the electric business, as the acquisition of such experience up to a few years ago proved very costly to the fire underwriters and others as well.

Gradually fire insurance associations appointed one or more inspectors to examine the electric light wires, lamps and fixtures installed in their territory and enforce certain rules and requirements generally made by themselves. With the rapid advance of the electrical industries changes in these were inevitable, but lack of uniformity proved to be a crying evil. The best and most reasonable requirements were formulated in the sections of the country where the electric light had found a foothold earliest. Most of the inspectors, instead of profiting by the experience of those longest in the business and adopting the rules formulated by them, insisted on issuing productions of their own, so that the so-called insurance rules differed as widely as the excise laws of Maine and New York. Some sections of the country were fortunate enough to have men who were empowered to make rules and enforce them, whose elevation to such position did not make them dizzy and cause them to issue impractical requirements, the enforcement of which did not always serve any good purpose, but made life a burden to those who were so fortunate as to come under their jurisdiction, whether manufacturers, contractors or producers of electrical energy. But other sections were not so fortunate. Among all the burdens that those in the electrical business have had to bear in the past, the whims and caprices of the authors of insurance rules were not the least.

The loss of time and money caused by conflicting requirements became so great in time, a movement was inaugurated by this association for securing uniformity of rules, a codification of the best and the repeal of the productions of cranks and impracticals. This task was accomplished by your former committee, the results of its labors were approved and the first national code was issued by this association. It was also adopted by the insurance associations, who thus recognized the good work performed. After the issue of this national code it was thought that all the troubles here described were ended, such, however, was not the case, for while representative men of the fire insurance associations agreed that the electrical engineers and electric light superintendents were the proper persons to formulate the rules and requirements, and the insurance associations to enforce them, there were others holding subordinate positions who could not bear to have this sentiment put in practice. As a result of such feeling an organization known as "The Underwriters National Electric association," which has claimed the sole right to issue new or amend the original rules first issued by this association, and has in the past insisted that the electric and allied interest should have no voice therein. As time rolled by and the organization increased in numbers this sentiment has changed somewhat as a result of the influence of broad minded practical men who are members of it and to the efforts of your former and present committee; and last, but not least, to those of the National Conference on Standard Electrical Rules, which was organized through the untiring efforts of the chairman of the committee on standard rules for electrical construction and operation, W. J. Hammer, and his associates.

As a result of our combined efforts the last codification of and amendments to the national code is the result of the combined efforts of the National Conference on Standard Electric Rules and the Underwriters National Electric association. The right to do this is what your committees have contended for in the past and have finally obtained. Your present committee on standard electric rules selected its chairman to represent you in the National Conference on Standard Electrical Rules, which was organized at a meeting held in New York on March 18 and 19, 1896, of representatives of insurance, electrical and kindred interests, consisting of the following organizations:

National Electric Light association, American Institute of Electrical Engineers, American Street Railway association, National Board of Fire Underwriters, American Institute of Architects, International Association of Fire Engineers, Underwriters National Electric association, Factory Mutual Insurance association, American Society of Mechanical Engineers, Western Union Telegraph company, Postal Telegraph company, American Bell Telephone company, General Electric company, Westinghouse Electric company. The complete list of official delegates, complimentary delegates and organizations to whom invitations were extended can be found in the report of the committee presented at the last convention and published in the last volume of this association's proceedings. That body appointed a committee on code consisting of seven members, one of whom was your representative. To this committee was assigned the task of amending and codifying standard electrical rules. At the time of the last meeting of the National Conference on Standard Electrical Rules, a large amount of work was done by representatives of the various electrical, insurance, architectural and allied interests, tending toward the adoption of the one single standard code of rules. A pamphlet had been prepared embracing the various codes used most extensively in this country and abroad; and after these had been in substance considered, and many changes, omissions and additions suggested, it was deemed desirable that the results of the two days' careful discussion should be handed over to a special committee of seven, with the president a member ex-officio, which committee should draft a code based upon the lines suggested, and then refer the same back to the conference for its approval.

Since the meeting of the conference, the committee has by meetings and correspondence carefully taken up the work assigned to it. The most important meetings were held October 16 and 17 and December 11 and 12, 1896. Between these two dates, *i. e.*, December 8th and 9th, the annual meeting of the Underwriters' National Electric association was held, and at the October meeting of the code committee it was decided that the committee, through one of its members (Mr. Merrill), should submit the draft already prepared by them to the Underwriters' National Electric association to secure the benefit of their criticisms and suggestions, and with a view of insuring a hearty co-operation upon their part. It was arranged that a joint meeting should be held of our committee of the code and a

1. Report of committee of National Electric Light association on standard electrical rules, read at Niagara Falls, June 8, 1897.

committee from their association, to facilitate the preparation of the final draft of the code. This meeting, held in December, 1896, was very successful, and it was jointly agreed by the two committees that the title of the new set of rules was to be "The National Electrical Code;" that the National Board of Fire Underwriters in printing the code should give on the inside of the cover due credit to the National Conference for its work, and place upon the cover the names of all the associations forming the National Conference as fast as these bodies gave their indorsements of the code; and that as far as possible the code should be left in the form as then presented, save that the classification as recommended by Mr. French be tentatively adopted, and after being set up by the printer, be submitted for final consideration by the members of both committees. The members of the code committee of the National Conference having met in New York on May 19, 1897, passed the following resolutions:

Resolved, That each delegate who attended the National Conference on Standard Electrical Rules be sent a copy of the standard electrical code, stating that said code had met with the approval of the code committee of the National Conference and the code committee of the Underwriters' National Electric association, and stating the belief of our committee that there was no necessity for calling the conference together as a body again, entailing, as it would, a very considerable sacrifice of time and money, and requesting their immediate reply, if they acquiesce in this recommendation, and approve of the report submitted by the committee and by the president, secretary and treasurer of the conference itself. In the event of their objecting and desiring that the conference be called together as a body to receive the committee's report, answer is to be made within 10 days, or their opinion is to be considered as favorable, and the code and reports published through the press by the code committee, and each delegate represented at the conference requested to bring same formally before his association for approval.

A meeting of the committee was held in Boston on June 5th, at which its previous action was ratified and the code as a whole unanimously adopted. The National Electric Light association was the first to adopt and issue a national standard code of rules, and if it now adopts the new codification of them it will not only be indorsing the unanimous findings of its committee, but the unanimous action of the code committee of the National Conference on Electrical Rules, which conference was organized under the auspices of the association; but furthermore, it will be the first body represented in the National Conference to do so; and your committee earnestly recommends that it give its approval.

DISCUSSION.

CAPTAIN BROPHY: I believe I was one of the original members of the conference first held at Cape May to bring about this result. I have been a member of this committee from that time on, and have labored faithfully to bring about this end. Sometimes the task seemed almost hopeless, but I never was ready to yield the right of the men engaged in the electrical business to have their say in the formation of rules under which they were obliged to install their apparatus. As I said before, I have given both time and means to bring about this end. I hope to see it consummated; then I shall be satisfied and consider my task done.

J. I. AYER: As a member of this committee I have been associated with Captain Brophy for a number of years, and there is no one that knows better than I the immense amount of labor that he has devoted to this work. To appreciate what has been accomplished, you must take into consideration the attitude of the insurance interests, their refusal to recognize the rules of this association, and our repeated efforts to bring about some sort of harmony. Now we have not only done this, but we have gotten, as a result, associated with, us in indorsing the national code of rules, the American Institute of Electrical Engineers, a body which heretofore has refused to consider this question for the reason that it preferred to keep out of all commercial matters and keep the institute free from any association with commercial factors whatever. But it realized the importance of the subject and has given its influence to bring about this common result because it felt it was necessary for the development of practical electrical work on proper lines that every effort, every power, every influence, should be brought to bear to bring about a universally standard code and avoid the friction which had developed in the past. In addition the approval has been secured of the National Board of Fire Underwriters, the American Institute of Architects, the International Association of Fire Underwriters, the Underwriters' National Electric association, the Factory Mutual, covering all of the important insurance interests, and the American Street Railway association as well. I want to say right here, and I cannot say it too strongly, that Captain Brophy is the man that has done it. We have all done a little pushing and a little helping, but he has been the leader.

Heating and Lighting Plant for the University of Illinois.

A new central heating and lighting plant is to be installed for the purpose of supplying the various buildings of the University of Illinois at Champaign, Ill. The plant will be housed in a detached building, and some 2,000 feet of tunnels will be needed to contain the steam pipes and electric wires radiating from it. It is probable that two-phase alternating current dynamos will be installed for the service plant, and it is expected that there will be other machines, probably wound so that different voltages may be taken from the same generator, for the use of students. C. G. Armstrong of Chicago is preparing the plans

Central Electric Company's Railway Specialties.

Activity in meeting the demands of the electric railway trade is shown by the Central Electric company of Chicago, which is well equipped, both in theory and practice, to serve the interests of railway companies in tendering engineering advice or furnishing necessary supplies. Two of the specialties supplied by this company are herewith illustrated. Fig. 1 represents the company's straight-line self-locking hanger. Practical experience has proven that the constant pounding of the entire system by the trolley tends to loosen the cap on the top of the hanger, allowing the insulated bolt or stud to work loose from the ear or clip, resulting in the dropping of the trolley wire at that point. To avoid this difficulty the company has brought out the hanger shown by the cut. The cap is provided with small tips, which, being made of malleable iron, can be turned or pounded into the groove, thus prohibiting the working of the cap After having placed the hanger upon the line and locked it, it is in position for all time. The tensile strength of these hangers is many times greater than required, giving ample margin of safety.

FIG. 2. CENTRAL ELECTRIC COMPANY'S RAILWAY SPECIALTIES.

Fig. 2 shows the Central Electric clincher ear, which is made in 6, 7, 9, 12 and 15 inch lengths for No. 0, No. 00 and No. 0000 trolley wires or of special sizes to order. The standard ear is tapped for five-eighths inch stud, but the company can fill special orders for seven-sixteenths or one-half inch stud. The advantage of this clincher ear is that it requires no solder to place it upon the line, nor is it necessary to be in possession of special tools to satisfactorily install it. It offers to the trolley a perfectly straight underrun, thus reducing sparking to a minimum and adding to the life of the trolley wire and decreasing the expense of maintenance. An ear made in this form is more flexible and permits of bending, and thus offers to the trolley the continuity of a perfect plane.

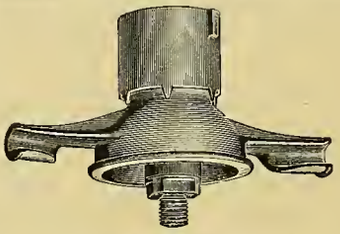
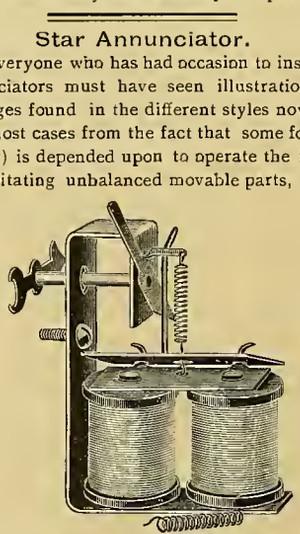


FIG. 1. CENTRAL ELECTRIC COMPANY'S RAILWAY SPECIALTIES.

Star Annunciator.

Nearly everyone who has had occasion to install or repair annunciators must have seen illustrations of the disadvantages found in the different styles now in use, arising in most cases from the fact that some force (usually gravity) is depended upon to operate the indicator, thus necessitating unbalanced movable parts, which in turn enable false indications to be produced or existing indications to be destroyed by a sudden mechanical shock or jar.



STAR ANNUNCIATOR.

In the drop illustrated it is believed that many such faults are overcome, owing in part to the fact that the indicator is directly moved by the armature, and is spring locked in both its indicating and normal positions, thus enabling the use of unbalanced parts to be dispensed with, preventing any jar or change in position from interfering with successful operation, and producing a positive action even when the electrical impulse is of very short duration.

Trouble heretofore experienced on account of the armature sticking to its magnet, will never exist, it is said, where this drop is used, as the action of returning the indicator to its normal position forces the armature a sufficient distance from the magnets.

By an ingenious arrangement no retracting spring is required for the armature, and the energy absorbed by the locking spring when the indicator starts is subsequently applied to complete its rotation, thus enabling the drop to operate successfully on a minimum amount of battery.

This desirable annunciator is manufactured and sold by the Star Electric company of 25 Front street, Binghamton, N. Y., which has a good reputation for quality of materials and workmanship.

National Electrical Code.

Under date of July 12th, Dr. F. B. Crocker, chairman of the code committee of the National Conference on Standard Electrical Rules, and C. M. Goddard, press committee of the Underwriters' National Electric association, have issued the "National Electrical Code," together with an historical sketch of the making of the rules covering electric light and power wiring in this country. This sketch was prepared by the code committee of the National Conference on Standard Rules and the committee on press of the Underwriters' National Electric association jointly, and is herewith presented:

The long desired uniformity in the code of rules for electrical installations would seem to have now become an accomplished fact, as the new edition of the rules of the National Board of Fire Underwriters, as recommended by the Underwriters' National Electric association, which is just from the press, is identical with that which has received the unanimous approval of the code committee of the National Conference on Standard Electrical Rules, who have referred it to the various delegates in the conference, with recommendation that they report it to their respective organizations for adoption or approval.

It has been thought advisable that in presenting these rules to the public, they be accompanied by a sketch of the manner in which this uniformity of rules has been brought about, and this article has been prepared jointly by the code committee of the National Conference and the committee on press of the Underwriters' National Electric association, in order to show the various stages through which these rules have passed, and the successful work of the National Conference in securing harmony among the divers interests which they affect.

As the adoption of a uniform set of rules for the safe installation of electric light and power apparatus, by the electrical, insurance and allied interests, marks a distinct epoch in the history of rule making in this country, it seems a proper time to give a brief outline of the evolution of electrical rules from the crude beginnings of 15 or 16 years ago up to the present time, when the rules in force are as nearly perfect as the combined experience of interested parties has been able to make them.

After a large amount of correspondence, inquiry and consultation of records, the following data has been collected.

It seems that to the New York Board of Fire Underwriters belongs the credit of the first printed requirements in relation to electric lighting. On October 19, 1881, a circular was issued by that board containing the following resolution:

Resolved, That the committee on police and origin of fires are hereby directed to notify the owners and occupants of all buildings in which uncovered electric light wires, or in which arc lights with open bottoms or without globes, are found, that the wires must be covered, and the lamps altered to conform to the rules of this board within 10 days from date of notice and request that the lights shall not be used until the alterations are made; and in case the alterations are not made within said time, the committee are hereby directed to notify the members of the board of said failure, and the companies insuring said property are hereby recommended to give notice to the owners and occupants or such buildings that unless the request is complied with and the alterations made within a reasonable time, that the insurance on said property will be canceled.

The Boston Manufacturers' Mutual Fire Insurance company comes in one day later with a circular dated October 20, 1881, calling attention to the same hazards from arc lighting.

Under date of January 12, 1882, the New York board issued a very brief circular containing a few rules for the installation of electric lights; and in January, February and March of the same year, the Boston Manufacturers' Mutual Fire Insurance company issued circulars on this subject, in which the elements of later developments are shown by the classification of the requirements under the headings of dynamo machines, wires, arc lamps and incandescent lamps.

On May 19, 1882, the National Board of Fire Underwriters adopted the standard requirements of the New York board for the installation of electric lights, and in the same month the Boston Board of Fire Underwriters issued a circular containing similar rules.

On August 1, 1885, the New England Insurance Exchange issued rules covering both arc and incandescent systems. Previous to that time they had used the rules of the Boston board, issued in 1882. The rules of the New England Insurance Exchange were perhaps the most complete that had yet been put in print, and in a report of the electric light committee of that body it is stated

that in the arrangement of these rules they were "largely aided by some of the leading electric light people."

At a meeting of the National Electric Light association in Baltimore, in 1885, a representative of the Boston board and also of the Boston Manufacturers' Mutual Fire Insurance company were present; and, while there was considerable talk and discussion on the matter of rules, nothing was carried to an issue. In the following summer a joint conference of certain insurance representatives and members of the National Electric Light association insurance committee formulated rules, which were later presented to the National Electric Light association, but were not adopted. The rules resulting from this conference were promulgated simultaneously by the Boston Fire Underwriters' Union and New England Insurance Exchange, under date of May 15, 1889, and these rules, it may be said, were the first which fairly deserve to be called comprehensive, as the rules of other insurance boards, as late as January, 1890, were still very brief and incomplete.

In February, April, July and August, 1890, quite complete rules were issued by the Philadelphia Underwriters' association, Underwriters' Association of New York State and the Pacific Insurance Union, and jointly by the Boston Fire Underwriters' Union, Boston Manufacturers' Mutual Fire Insurance company and the Electric Mutual Insurance company.

In August, 1890, at the Cape May meeting of the National Electric Light association, a joint conference between members of the association and insurance representatives was held, which agreed on a large number of points, which were reported to the National Electric Light association, and a conference committee, consisting of representatives from the insurance and electrical interests, was formed under the name of the National Electro-insurance Bureau.

In September, 1890, the New England Insurance Exchange prepared, in conjunction with a committee from the New England Electric Exchange, a set of rules which met with the hearty approval of the Electric Exchange, and on November 18, 1891, the New York Board of Fire Underwriters also issued a set of rules.

In September, 1891, the National Electric Light association adopted the code of rules prepared by the National Electro-insurance Bureau, which were the first published by that association; but as there was no special effort on the part of that association or the Electro-insurance Bureau to secure the general adoption of the rules, they were adopted by only three or four insurance boards, covering a small portion of the United States; and some of these boards in publishing the rules made changes to suit themselves, basing their rules on those adopted by the National Electric Light association at their 1891 meeting. Most of the insurance boards continued to use the rules which had so recently been sent out by them, as they had no pressure brought to bear upon them in the interest of uniformity.

In the early part of the year 1892 the secretary of the New England Insurance Exchange, in the interests of uniformity of rules, corresponded with the electrical inspectors of the various underwriters' organizations in the eastern part of the United States, suggesting that a meeting be held in New York city in August. This idea seemed to meet with favorable consideration, and on August 18th representatives of the underwriters' boards, covering the New England, middle, south Atlantic and gulf states, met in New York, and taking as a basis the rules which had been adopted by the National Electric Light association, they carefully considered them, section by section, in order to make such changes as the experience of the insurance inspectors indicated to be necessary in the interests of the insurance companies.

The interest in this effort for uniformity of rules, so far as the insurance companies were concerned, was so great that it was decided to hold a meeting in New York in December of the same year, and to invite the inspectors of all the insurance boards in the United States and Canada to be present. The rules, as revised at the first meeting, were put in print; copies were sent with the call for the meeting to be held on December 6th, and it was also voted that a committee take into consideration the matter of permanent organization. The response to the invitation to this meeting was very favorable, and representatives were present from underwriters' organizations which covered practically the whole of the United States and a large part of Canada. A permanent organization was effected and an electrical committee appointed, consisting of electricians in the employ of the insurance interests, whose duties were to be the care of the rules, the making of tests, and the giving of information and advice to members of the association. The proof of rules prepared at the August meeting was again carefully gone over and revised, and the members present pledged themselves to use their influence to have their associations adopt these rules.

Proofs of the rules were sent to various prominent electrical interests, with a request that they examine them and submit any suggestions which they might desire to make. The committee received a report from the officers of the Edison Electric Illuminating company of New York city, in which it was stated that these rules in general were far in advance of any heretofore published, so far as they were aware, either here or abroad.

These rules were issued under date of March 20, 1893, and were almost immediately adopted by the following fire underwriters' organizations: National Board of Fire Underwriters, New England Insurance Exchange, New Hampshire Board of Fire Underwriters, Boston Board of Fire Underwriters, Suburban Underwriters' association, Underwriters' association of New York State, Philadelphia Fire Underwriters' association, Underwriters' association of the Middle Department, Pacific Insurance Union, Western Union, Association of Fire Underwriters for Arkansas, Chicago Fire Underwriters' association, Cleveland Board of Underwriters, Underwriters' association of Cincinnati, Detroit Board of Underwriters. So that, with the exception of New York city and the south Atlantic and gulf states, very general uniformity of insurance rules was secured in less than one year after the first meeting of the insurance inspectors.

The next meeting of the Underwriters' National Electric association was held in Chicago, on August 17, 1893, and an adjourned meeting was held in Boston on September 5th. The rules were again gone over carefully, section by section, revised, and amended. The general subject of the rules was divided into classes, and each member of the electrical committee assigned to some particular subject as his special field.

At the Washington meeting of the National Electric Light association, beginning February 27, 1894, a revised edition of the rules of the association was presented by the committee on safe wiring, and adopted.

Under date of June 15, 1894, the Underwriters' National Electric association issued a bulletin advising that the New York Board of Fire Underwriters, covering New York City, Buffalo Association of Fire Underwriters, Michigan Inspection Bureau, Southeastern Tariff association, Milwaukee Board of Fire Underwriters, Memphis Board of Underwriters, had adopted the rules of the association, and in August, 1894, the Associated Factory Mutual Fire Insurance Companies also adopted the rules, with a few modifications, so that in less than two years, so far as the insurance rules were concerned, uniformity had been secured; and at the meeting of the association held December, 1894, on account of the fact that certain boards had issued some slight amendments and additions supplementary to the rules, thus, to a certain extent, destroying the uniformity which had been secured, it was voted that the secretary correspond with the various associations, asking them to have their rules printed only by the National Board of Fire Underwriters, and to make no changes in, or additions to, these rules, except as promulgated through the National Board on recommendation of the electrical committee of the Underwriters' National Electric association.

In the meantime a bureau for the testing of devices and materials, and for the dissemination of information had been established at Chicago, in charge of a member of the electrical committee, and quarterly reports were issued containing brief accounts of fires in all parts of the country due to electricity; also, bulletins were issued from time to time containing reports of tests of wires, devices, and materials.

The object for which this association was started, that is, the securing of uniformity of rules to be enforced by insurance inspectors, having been practically accomplished, and the results of the work of the committee having apparently proven themselves to be proper and satisfactory, the committee felt that they were now in a position to invite general criticisms from all those engaged in the electrical business. Their rules had been adopted by practically all of the underwriters' organizations, 40 of which were using rules printed from the same type; they had been incorporated in the ordinances of 15 or 20 cities, and had received the hearty approval of representatives of many of the most prominent manufacturers and central station men. Early in October, 1895, the committee sent out a circular letter with blanks, practically broadcast, inviting any suggestions for changes or additions in the present rules. Many such suggestions were sent in, and at the December, 1895, meeting they received careful consideration. At this meeting the discussions and votes were not confined to members of the electrical committee, but the full privileges of both discussions and voting were extended to all present, and there were representatives at this meeting from several municipal inspection departments, who took active part in the matters before the committee.

There was still a feeling, however, that the electrical interests did not have as full an opportunity to express themselves on these rules as they were entitled to, and under date of October 15, 1895, a communication was sent to various associations on behalf of the National Electric Light association and their committee on standard rules, containing resolutions adopted by that committee in September of that year, suggesting a joint conference composed of delegates from the following associations: American Institute of Electrical Engineers, American Street Railway association, National Board of Fire Underwriters, American Institute of Architects, International Fire Chiefs' association, American Bell Telephone company, Western Union Telegraph company, Postal Telegraph company, General Electric company, Westinghouse Electric & Manufacturing company, National Electric Light association, who should "undertake the codification, promulgation and enforcement of one standard set of rules, which shall meet as fully as possible the conditions that now exist, and be acceptable to all electrical, insurance and allied interests."

Later the Underwriters' National Electric association, the American Society of Mechanical Engineers and the Factory Mutual Fire Insurance companies were invited to send delegates, and certain others were invited as complimentary delegates.

From this meeting the National Conference on Standard Electrical Rules was organized in New York on March 18 and 19, 1896, and the voting delegates were limited to those from the American Institute of Architects, American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Street Railway association, Factory Mutual Fire Insurance companies, National Association of Fire Engineers, National Board of Fire Underwriters, National Electric Light association, Underwriters' National Electric association.

A committee on code was appointed, to whom was assigned the task of amending and codifying the standard electrical rules. A pamphlet had been prepared, embracing the various codes, printed in parallel columns. These were carefully discussed, and it was decided that the rules promulgated by the Underwriters' National Electric association were the most feasible ones to take as a basis. The results of the consideration by the conference were referred to the code committee, and that committee met in New York, in October, 1896, and prepared a number of suggestions for changes and additions in the underwriters' rules. These were referred to the Underwriters' National Electric association, through the representative of the National Board of Fire Underwriters. At the annual meeting of the electrical committee on December 8, 1896, the suggestions from the code committtee of the conference, together with other suggestions from various sources, were considered, and on December 11th, several members of the electrical committee met with the code committee of the conference, and a report was made, showing that nearly all of the conference suggestions had been adopted, and giving the reasons why those which were rejected did not meet with approval.

At the meeting of the electrical committee of the Underwriters' National Electric association a sub-committee was appointed to recodify the rules, as the changes in the electrical industry had made obsolete the classification of 1892, and it was difficult to incorporate amendments and additions under the proper heading. The committee was instructed to make this re-codification, so far as possible, without changing the rules themselves, and to submit the results of their work to the electrical committee for approval. This work of re-codification was duly undertaken, but proved to be a work of considerable magnitude, which will account for the delay of some six months in issuing the rules, as the results of the re-codification were to be submitted in proof to the electrical committee of the Underwriters' National Electric association for approval, and were also submitted to the code committee of the National Conference, and meetings of that committee with the recodification committee were held in New York in May and in Boston in June. The rules as re-codified had already been adopted by the Underwriters' National Electric association and the National Board of Fire Underwriters, and the code committee of the National Conference passed the following resolution:

Resolved, That each delegate who attended the National Conference on Standard Electrical Rules be sent a copy of the Standard Electrical Code, stating that said code had met with the approval of the code committee of the National Conference and the code committee of the Underwriters' National association, and stating the belief of our committee that there was no necessity for calling the conference together as a body again, entailing, as it would, a very considerable sacrifice of time and money, and requesting their immediate reply if they acquiesce in this recommendation, and approve of the report submitted by the committee, and by the president, secretary and treasurer of the conference itself. In the event of their objecting, and desiring that the conference as a body be called together as a body to receive the committee's report, answer is to be made within 10 days, or their opinion is to considered as favorable, and the code and reports published through the press by the code committee, and each delegate represented at the conference requested to bring same formally before his association for approval.

The rules of the National Board of Fire Underwriters are now printed with the following note:

The National Electrical Code, as it is here presented, is the result of the united efforts of the various electrical, insurance, architectural and allied interests, which have, through the National Conference on Standard Electrical Rules, composed of delegates from the following associations, unanimously voted to recommend them to their respective associations for approval or adoption:

American Institute of Architects, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Street Railway association, Factory Mutual Fire Insurance companies, National Association of Fire Engineers, National Board of Fire Underwriters, National Electric Light association, Underwriters' National Electric association. And as soon as meetings of these associations are held, and action taken, the fact will be noted.

These rules received the approval of the National Electric Light association at its meeting at Niagara Falls, held June 8th of the present year, and will, undoubtedly, receive the approval of the other associations represented in the National Conference; so that now for the first time a "National Electrical Code" is issued, stamped with the approval not only of the insurance interests, but also of the national societies of electrical, architectural and allied interests.

From the foregoing sketch it is evident that the underwriters have from the beginning availed themselves of the advice and suggestions of the electric interests. The 1885 edition of the New England Insurance Exchange rules was prepared with the "aid of some of the leading electric light people." Insurance representatives were present at the Baltimore meeting of the National Electric Light association in 1886, and while that association took no action on the rules which came from this and later meetings, they were recognized and adopted by the Boston board and New England Insurance Exchange in 1889. The rules of the New England Insurance Exchange issued in 1890 were submitted to and approved by the New England Electric Exchange, and when the Underwriters' National Electric association was organized in 1892 it took as a basis of its rules those which had been formulated in 1891 for the National Electric Light association by the Electro-Insurance Bureau. The rules prepared by the Underwriters' National Electric association were submitted to, and received the hearty approval of, representative electrical experts. The insurance interests, however, have always felt that it was their province to settle what should be the electrical equipment of risks which they insured. This course has always been pursued in England, where the Phœnix Fire Office Rules are practically the only

ones recognized, and it is a position which can be well defended, and must be admitted to be entirely reasonable. It is equally true that the underwriters should not be arbitrary and overbearing, and should make their rules as favorable to the electrical interests as the overcoming of the fire hazard will permit; and we believe that the facts show that this course has been generally maintained.

The principal reason why harmonious relations between the electrical and insurance interests in the matter of uniform rules has not sooner been reached is, we believe, because there was no organization through which the electrical, architectural and allied interests could be reached until the National Conference on Standard Electrical Rules was formed. For the same reason uniformity of rules in the various insurance boards was not accomplished until the formation of the Underwriters' National Electric association, an organization through which the various boards could be reached, and in which they had a voice. Just as soon as this association was formed, uniformity of rules, so far as the insurance interests were concerned, became an accomplished fact, and just as soon as an organization of the other interests was formed, complete uniformity of rules was secured.

In the joint meetings between the code committee of the National Conference and the electrical committee of the Underwriters' National Electric association the utmost harmony has prevailed, and suggestions from either have been most courteously considered by the other. If the Underwriters' National Electric association had not been formed for the purpose of uniting the many independent underwriters' organizations, and had it not been for their ready and cheerful co-operation, it is probable that the National Conference could not have brought about the result for which they were working. The efforts of the members of the code committee of the National Conference to secure harmony and uniformity are most certainly appreciated, not only by the electrical, but by the insurance interests as well.

As matters now stand the conference has accomplished its work, and has adjourned. The organization remains, and the work that it has done stands as a precedent, so that, should occasion ever again demand, the machinery could be easily put into motion.

It is recognized that from time to time changes in the rules will have to be made to meet the natural growth in electrical lines; it is, however, felt that, considering the very satisfactory results now secured, and the slight changes needed in all probability for several years to come, that the Underwriters' National Electric association is the most available body to charge with this work of revision for the immediate present.

To keep the conference in commission to do this work is rather difficult, as it requires more time and attention from men otherwise very busy than the needs seem to warrant.

It is the purpose of the Underwriters' association to give in the future, as it has endeavored to do in the past, the fullest hearing on all criticisms, and the members of the National Conference will be fully welcomed and with full privilege of voting at the underwriters' meeting, thus giving the very largest liberty and breadth to the makeup of the Underwriters' association.

Power from Refuse Destructors.

A dispatch from London states that on June 28th an important economic and scientific experiment was begun. Lord Kelvin opened at Shoreditch the combined electricity and dust destruction works erected at a cost of about $750,000. The destructor cells are capable of burning 20,000 tons of ashbin refuse yearly, and the heat given out is sufficient for the electric light and power of the whole of Shoreditch, with a population of 124,000, beside supplying heat to the adjoining baths and washhouses.

In Paris lamps will be lighted by electricity furnished by a destructor.

This unique municipal enterprise is exciting the liveliest interest in scientific and municipal circles in Great Britain and abroad. If successful it promises to revolutionize the public supply of electricity, as the vestry of Shoreditch promises to supply electricity at two pence (four cents) per unit in the daytime, and at four pence (eight cents) at night-time.

During a preliminary test 150 pounds pressure of steam was raised in the boilers from dust alone, absolutely no coal being used.

CORRESPONDENCE.

New York Notes.

NEW YORK, July 13.—The proposal for an electric railway to connect this city and Philadelphia is again brought to public notice by the action of the New York & Philadelphia Traction company in beginning the construction of a trolley road between Somerville and Bound Brook, N. J. This is said to be the first link in the system. Of course there will be opposition, and at the present time the New Brunswick Traction company seems to be leading the fight on the proposed line.

The American Electrical Maintenance company has been incorporated here with a capital stock of $250,000. The company proposes to contract with the owners of electrical dynamos and plants to keep them in repair for a stipulated yearly sum. The directors are Henry A. Root and Arthur Hilton of Boston, and Alfred K. Warren, George H. Cook, George Stanmore, James R. Steers, Edward R. Johnes, William Duryea and Henry B. Wilson of New York.

Another big power scheme on the border of this state is progressing. The St. Lawrence Power company of Massena Springs, N. Y., has awarded to John W. Grellin of Hazleton, Pa., the contract for a canal excavation in St. Lawrence county, between the St. Lawrence and Glass rivers. The canal will be three miles in length and will require about two years to complete. The purpose of the canal is to secure a waterfall and establish an electric plant similar to that at Niagara Falls. Westinghouse 5,000 horse power dynamos will be used. The two streams running parallel at the place selected, a fall of 48 feet is obtained, with natural declivities in places that will make it, it is asserted, second only to the famous Niagara power.

The complaint of the Knights of Labor, District Assembly 75, of New York city, alleging that the Metropolitan Street Railway company violated the law in failing to issue transfer tickets at certain points, was dismissed by the state railroad commission on July 8th. An important feature of the opinion was that portion showing the extent of the transfer system of the company. The report says: "There are now 290 points at which transfers are given by the company, and it is estimated on the basis of the business for nine months, that the number of passengers who received transfers for the year ending June 30, 1897, was 65,000,000, as against 185,000,000 cash fare passengers. For the year ending June 30, 1896, about 175,000,000 cash passengers were carried and nearly 45,000,000 transfers given, an increase of 20,000,000 transfers and 10,000,000 cash fare passengers for the year 1897."

The Kings County and the Brooklyn Elevated Railroad companies have applied to the Department of Assessments for a reduction of the assessed valuation on their roads from $150,000 to $100,000 a mile. President Uhlmann of the Brooklyn company said that since the introduction of the trolley system both the elevated railroads had been compelled to go into the hands of receivers, and that it was a struggle for them to exist. He showed that there was a deficiency of $194,235 for 1896 in the Brooklyn company, while the Kings County road had a deficiency of $107,256 for the same year. Treasurer Frothingham of the Kings County road said the receipts for May were $2,331 35 less than for the same month in 1896. M. S.

New England News.

BOSTON, July 13.—The contract for the great electric plant for the new South Union station, which has just been let by the Boston Terminal company to the Westinghouse interests, comprises an unusually comprehensive and complete engineering equipment and will require an expenditure of half a million of dollars. The various departments of the work, each of which is quite complete in itself, and yet more or less connected with the others, include interlocking and switching and signaling apparatus; an extensive power house equipment for furnishing steam, electricity, compressed air and heat for the Terminal company's needs; an equipment of elevators and lifts for passenger, freight and baggage service; the heating and ventilation of the various buildings; a plant for making ice for use in cars, restaurant, etc.; a refrigerating plant for mechanically cooling provision boxes and storage rooms in the head house; a plant for filtering and cooling drinking water for the public and for the use in the offices; provisions for heating cars when standing in the train shed and yards while the locomotive is detached; an equipment for testing air brakes before the trains are sent out from the station; a fire protective service for the terminal buildings; pumping apparatus for disposing of water which may find its way into the portions of the property situated below tide water; provisions for preventing the freezing of water in the leaders which are to carry away rain and melting snow and ice from the immense roof and train shed areas; furnishing supplies of steam and hot water in the head house, etc.

The switching and signaling system will include a complete installation of Westinghouse electro-pneumatic interlocking apparatus for handling all the trains of the four railroads to and from the main train shed, and for handling the frequent trains of the suburban service which are to use the tracks in the depressed suburban loop. Several hundred levers will be installed for handling the switches and signals, and two interlocking towers will be built for the reception of the interlocking machines and for the use of the men who are to operate them. In each of these interlocking towers operating models of the tracks will be placed, upon which each movement of the switches and signals will be duplicated in miniature, so that the operators will always have before them the exact arrangement of the section of the track under their control. The signals will constitute a complicated system somewhat similar to that in use at the northern station but more extensive, and will embody a number of improvements. The switches and signals will be operated by compressed air furnished from the power house and controlled electrically by the interlocking machines in the towers. The signals will be located in some cases on the ground level, but principally on eight or nine signal bridges, varying in span from 50 feet to 120 feet.

The power house equipment will comprise 10 boilers, economizers and a large mechanical draft plant. About 1,500 horse power of Westinghouse compound engines direct-connected to Westinghouse multipolar dynamos will be installed in the engine room. The plant will be operated condensing, using salt water from Fort Point Channel, about 100 feet from the engine room, except when exhaust steam is required for heating or other purposes. A large switchboard providing for a dozen or more circuits for the various uses of electric current will be used; and the entire installation will be of the most complete character and especially adapted to the miscellaneous and varying requirements of the terminal service. A traveling crane will span the engine room. The electric arc and incandescent lighting is laid out with special reference to the character of the service, leading to the employment of a larger number of distributing centers than is customary in isolated plants, and complete methods of switching are to be provided in order to meet the demands of the lighting and motor circuits and to aid in economizing power.

The elevator equipment is to comprise 19 electric elevators and lifts, distributed through the head house, train sheds and baggage rooms. Several of these are for passenger service, two are for handling supplies for the restaurant and other similar uses, and the remaining are for handling baggage and express between the train shed suburban loop levels.

The head house and baggage wings, which form a building extending around three sides of the train shed, and having a total length of more than 200 feet, are to be heated and ventilated on an extensive scale. This is to be done with various combinations of the direct and indirect methods. Hot blast and tempered air is to be furnished by fans which are to be driven by electric motors. The ventilation is to be assisted by electrically driven exhaust fans located in the attics, and entirely separate means are to be provided for the toilet rooms.

Ice for general use is to be manufactured on the premises in an ice plant which will make 20 tons of ice per day. This ice plant is to be conveniently located between the power house and one of the baggage wings. The restaurant and the storage rooms are to be cooled by a refrigerating plant, and the same plant will be used for cooling the supply of drinking water for general use.

An extensive system of steam and compressed air piping is to be installed in the yards and train shed and connected with about 50 stub-tracks for warming the cars while they are standing on the tracks in cold weather, and to furnish a suitable supply of compressed air for testing the air-brakes prior to the departure of the trains. This is an important feature in all terminal work, and in this instance it will be unusually good. For the protection of the head house and adjacent buildings a system of fire service mains and distributing lines connected with the Boston high-pressure mains, and provided with a large number of outlets, is to be fitted with hose and reels ready for immediate use when needed. The disposal of water from the water-proofed structure involves somewhat unusual consideration, due to the fact that a large part of the basements and all of the suburban loops are to be below tidewater. Near the power house, therefore, electrically driven centrifugal pumps will be installed to pump away any possible sewage and storm water which, owing to the grades of the suburban tracks, will necessarily be carried to the lower levels. The electrical pumping apparatus is to be controlled automatically by the level of the water in the pump, and a large reserve pump is to be installed to handle unusual quantities of water. Electric alarms are to be provided to notify the power house attendants to start the large pump whenever the water reaches a predetermined level.

The occasion for the protection of the water conduct-

ors arises from there being some 14 acres of roofs, from which storm water, melting snow and ice, are to be carried away by many large conductors, the freezing of which in winter would cause great inconvenience. Special provision is, therefore, to be made to keep them constantly open.

A system of hot water and steam supply is to be provided for the head house to take care of especial all-year-round service, and this is to be wholly separate from the heating system, which will be used only in cold weather.

The letting of this contract completes the arrangement for the construction of the principal portions of the new terminal station. As a whole it was designed by George P. Francis, C. E., engineer of the Boston Terminal company, under the direction of the management of the the Terminal company and of the chief engineers of the various roads, the New York, New Haven & Hartford, the Boston & Albany, and the New York & New England, which will ultimately use the station. The complete mechanical engineering equipment was designed by Westinghouse, Church, Kerr & Co. C. S. G.

Northwestern Notations.

MINNEAPOLIS, July 13.—The engineer of the electric light plant at Redwood Falls, Minn., made a big catch of bullheads. He went to turn the wheel governing the water-wheel but found it impossible and at last turned off the headgates. In the morning he found 13 bullheads, weighing about one pound each, caught in the wheel.

The receiver of the Belle City Railway company of Racine, Wis., has filed a petition and an order to show cause why the property should not be sold at auction. There was no opposition and the court granted the order and set the date of sale.

The electric light plant at Spencer, Ia., was sold to the First National Bank of that place, for $10,000, at the Sheriff's sale.

The electric light plant of Perry, Ia , contemplates enlarging its plant.

The Chippewa Falls, Wis., Council has granted a franchise to the Chippewa Valley Street Railway company to build an electric line between Chippewa Falls and Eau Claire and work will be begun at once.

C. F. Loweth, engineer of St. Paul, estimates the cost of an electric light plant for Barnesville, Minn., with water works in connection, at $19,300.

The Ohio Construction company has announced that it will pay the debt of the old street railway company at Neenah, Wis., and will build an electric line to Kaukauna. This is intended to head off Henry C. Payne's project of an interurban line.

C. B. Pride, C. E., of Appleton, Wis., has prepared plans for the development of the Apple river water power near New Richmond, Wis., for the Apple River Power company to generate electricity.

The Western Electric company of Chicago secured the contract to install an electric light plant at the state insane hospital at Oshkosh, Wis., for $14,500.

The Chatfield Electric Light & Power company of Chatfield, Minn., is having plans for its system prepared by F. F. Vater of Minneapolis.

J. B. Nauert has been granted an electric light franchise at Boscobel, Wis.

An electric pump is being placed in the capitol building in Bismarck, N. D., to keep the tank full. It works automatically, always keeping the water at a certain depth.

The street car company has won in a case at Duluth, Minn., against the Northern Pacific railway, in which it sought to cross the latter's tracks. The court held that the street car company could make the crossing, provided only that it should be safe for the operation of both tracks.

The electric light plant at Pipestone, Minn., was sold at auction by the sheriff and was bid in by the First National bank of this place at $5,301, just $1 more than the indebtedness against it.

Bids are being taken until July 23d for installing an electric lighting plant at the insane hospital at Rochester, Minn. Bids are to be sent to T. H. Titus, secretary, care the Hotel Ryan, St. Paul.

The Clarinda Electric Light & Power company of Clarinda, Ia., contemplates utilizing the water power and using storage batteries to store power through the day.

The Council of Crookston, Minn., has secured an estimate of cost for a municipal electric light plant for that city, of $127,000 for a steam plant. C.

PERSONAL.

Captain W. L. Candee of the Okonite company, New York, was a Chicago visitor early in the week.

J. McGhie of the New York office of the General Electric company sailed for London last week.

Frank A. Rogers, general manager of the Card Electric company of Mansfield, Ohio, was in Chicago during the week.

Max A. Berg, the popular secretary of the Ohio Brass company, Mansfield, Ohio, spent a few days' vacation among Chicago friends this week.

H. L. Gifford, the secretary and treasurer of the Cashier's Electric Safety Cabinet company of Cleveland, was in Chicago a few days ago. He reports an active interest in the ingenious machine which his company is introducing and is confident that it will win favor with banks and other large cash-handlers on its merits.

Columbus R. Cummings, a wealthy Chicago financier, died on July 12th. He was largely interested in electric street railway companies in South Chicago, Grand Rapids, Mich., and Peoria, Ill. He was also one of the organizers of the Cicero & Proviso Street Railway company, which operated the pioneer electric line about Chicago. Mr. Cummings was a considerable holder of telephone stock and a director of the Central Union Telephone company of Chicago. During his last illness Mr. Cummings' physicians forbade him to go up or down stairs, and he caused an electric elevator to be built in his residence, so that he might reach the level of the street from his bedroom on the second floor.

ELECTRIC LIGHTING.

The contract for the lighting plant for the state insane asylum at St. Joseph, Mo., will be let at 9 A. M. on July 20th. Plans can be seen at the asylum or at the office of A. L. McRae, consulting engineer, 306 Oriel building, St. Louis.

ELECTRIC RAILWAYS.

The Common Council of the city of Niagara Falls has taken a very firm position in regard to the employment of alien labor on the Niagara Falls & Lewiston or Gorge road. At a recent meeting it passed a resolution declaring the company's franchise null and void and giving it 30 days in which to remove its tracks from the streets of that city unless within that time the company discharged every alien employed on the road. Furthermore, the street superintendent was instructed to tear up the tracks and remove all wires of the road if the company did not comply in the specified time. This is evidence that the feeling of the aldermen is not very friendly for the Gorge road, and the step was taken to put an end to the employment of Canadians on the line. Of course the action has not had a tendency to increase the friendly feeling between the people on the border, for the alien labor question is an important one at the Falls, where the bridges afford such easy means of crossing the river.

TELEPHONE.

A commission has decided the case of condemnation proceedings of the Bell Telephone company of Buffalo against James D. McVean of Le Roy, N. Y., in favor of the telephone company. The action was instituted by the telephone company to acquire a right of way for poles along the highway in front of McVean's farm. The company offered $14, but this was refused. McVean will now receive $5, besides having to bear his share of the expense.

Articles of incorporation of the Interstate Telephone & Electric company were filed at Dubuque, Iowa, July 6th. The capital stock is $100,000. The president is F. F. Sapp, Chicago; secretary, E. T. Keim, Chicago; attorney, R. W. Stewart, Dubuque. The purpose announced is the construction of a toll-line exchange for the Dubuque Telephone company. It is stated that President Sapp is a capitalist and owner of independent telephone exchanges in several states.

TELEGRAPH.

According to dispatches just received in London, Lake Nyassa is now in telegraphic communication with the East African coast and with England. Large quantities of telegraph material are on their way into the interior of the Dark Continent for the purpose of carrying the line north and south as quickly as possible. Indeed, the only obstacle to the completion within a few months of a direct land line from the Cape of Good Hope to Cairo is the condition of the Soudan from 300 miles below Khartoum to 300 miles above it.

MISCELLANEOUS.

The United States Consul at Belize, British Honduras, reports that the Municipal Board of Belize is contemplating the erection of an electric lighting plant for lighting the streets and public buildings of the city, and he expresses the belief that there is an opportunity for American electrical manufacturers to install this plant. A telegraph line of about 200 miles in length is also to be constructed in the Belize consular district, and it is quite likely that a telephone line will be used in conjunction with it.

In reviewing an English book on patent law, the London *Electrician* says: "It [the international aspect of patent law] is a large and fruitful field where we may hope to see some further movements toward assimilation, in which direction the existing international convention may be looked upon as a first step. The recent announcement of some alterations in the United States patent law may perhaps be also a hopeful sign that further changes might possibly, in course of time, bring conflicting views in different parts of the world into harmony, and pave the way for an international patent law."

The annual meeting of the Western Republic Construction company of Chicago, which controls the Ogden Gas company and the Cosmopolitan Electric company, was held this week at the general offices of the company, 155 Washington street. The vote of the stockholders elected the following-named directors: Thomas Gahan, E. R. Brainard, Andrew J. Graham, Jacob Franks and Roger C. Sullivan. Andrew J. Graham is a new director, and he succeeds P. J. Sexton. Thomas Gahan and E. R. Brainard were re-elected president and vice-president respectively, and Roger C. Sullivan was elected secretary and treasurer, succeeding P. J. Sexton in the latter position. It was stated that no important changes in policy were considered at the meeting.

Advocates of the New York law providing for the infliction of capital punishment are compelled to make excuses for the failures and blunders that are being constantly made. According to the *Sun*, "the execution of Giuseppe Constantino at Auburn for a murder committed at Utica in January, 1896, was not a very striking illustration of the superiority of electricity over other methods of inflicting the death penalty. Five separate shocks had to be administered, and instead of the instantaneous death which the system was always to produce, a period of eight minutes was required to kill the criminal by means of the electric current. Somebody appears to have been to blame for not having the mechanism and appliances in the proper condition to act more speedily; and the superintendent of state prisons should see to it that the person thus at fault has nothing more to do with electrical executions in this state. We have anti-cruelty societies to insure painless death to decrepit, useless or objectionable animals; and having undertaken to establish a merciful method of capital punishment for men, the responsible authorities ought to make certain that it is carried out."

TRADE NEWS.

The Sterling Varnish company of Pittsburg, Pa., has recently ordered a 75 horse power Ball automatic engine for electrical purposes from the Ball Engine company, Erie, Pa.

Berthold Groote of Nuremberg, Germany, is exploiting the "Simplex" socket for incandescent lamps. This device is intended for use in exterior decorative lighting and consists, essentially, of two spring clips fixed to a porcelain base and intended to make contact with the copper conductors when the socket is placed in position. The advantages claimed are speed and convenience in placing the lamps. One man, without tools or experience, can, it is said, attach 300 lamps in an hour.

J. Holt Gates, western agent of the Walker company, has removed his offices to suite 1323 and 1324 Marquette building, Chicago, where he has much larger quarters. Mr. Gates also reports that he has taken the western agency of the Wagner Electric Manufacturing company's alternating current transformers, single-phase alternating current motors, alternating current instruments, switches, etc. Mr. Gates has also taken the western agency of the Card Electric company of Mansfield for slow-speed motors and dynamos.

The trade bulletins of the Bullock Electric Manufacturing company of Cincinnati contain much useful information for the engineer or buyer, and they are well arranged and handsomely illustrated. Recent issues describe "Multipolar Generators and Motors for Direct Current Lighting and Power" and "Direct-connected Slow-speed Motors" for machine tools. A bulletin treating of direct-connected generators will soon be issued, and it is expected that the new catalogue will be out in about six weeks. Copies of the bulletins, as they appear from time to time, giving special applications of the Bullock apparatus, will be furnished on application.

BUSINESS.

The National Electric company of 15 Michigan street, Cleveland, buys and sells new and second-hand machines and does rewinding and repairing of all kinds. A circular gives information and will be sent on request.

The Partridge Carbon company of Sandusky, Ohio, is very busy and reports more orders on its books than at any time within the last three years. Customers appear to be satisfied; the merits of the Partridge brushes tell in their favor.

The Chesapeake & Ohio Railroad company has ordered through Crook, Horner & Co., the Baltimore representatives of the Ball Engine company, Erie, Pa., two Ball engines for electrical purposes. One of these engines is direct-connected to a generator. The engines will be used at Newport News, Va.

The American Electric Heating corporation of Boston has, it says, sold over a thousand electric laundry and tailor irons in the last few months to make habitable domestic and commercial laundries during the summer months, as well as to effect positive economies in the cost of operation in most cases. The addition to the summer day load to many stations which can be effected

by electrically heated goods is an important element in solving the dividend problem. Electric heating for summer business should be investigated.

The severe competition in the manufacture of electric bells has resulted, it is said, in lowering the grade as well as the price of the regular electric house bell. Realizing the fact that the trade demanded a better article in the line of an iron box bell, the Electric Appliance company is placing on the market its Reliance iron box bell, which, it claims, is considerably better than anything in this line that has been placed on the market for some time. This bell cost, more money to make, but is put on the market at an honest price, and to meet the demand of customers who are willing to pay a fair price for a good article.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued July 6, 1897.

585,647. Electro-pneumatic Circuit Closer. Birney C. Batcheller, Brooklyn, N. Y. Application filed April 6, 1896.

The circuit-closing device is operated by the differential pressure incident to the passing of the carrier.

585,662. Switchboard for Central Telephone Stations. Charles E. Egan, Chicago, Ill. Application filed December 2, 1895.

Flexible arms having sockets mounted thereon and contact points on each side thereof included in the circuit of the signaling apparatus are features of the iovention.

585,663. Electric Attachment for Musical Instruments. William B. Fleming, Detroit, Mich. Application filed January 13, 1897.

There are provided a conductor in electrical connection with a roller, a shaft provided with a series of disks adjacent to the roller mounted upon the shaft and insulated one from the other, and spring contact arms in electrical connection with the disks.

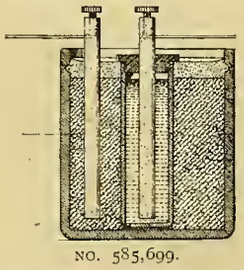
585,699. Reversible Primary Battery. Leon W. Pullen, Camden, N. J. Application filed October 23, 1896.

This battery comprises a suitable cathode, a depolarizing mass in contact therewith and consisting of a mixture of finely divided carbon, a salt of manganese and concentrated sulphuric acid uniformly distributed throughout the mixture, and an anode arranged in a dilute electrolyte.

585,707. Joint or Splice for Electric Wires or Cables and Method of Making Same. Ferdinand Schwedtmann, St. Louis, Mo. Application filed December 14, 1896.

The method consists in forming hooks in the ends of the wire or cable, interlocking the hooks, and then molding a conducting metal around the interlocked hooks.

585,726. Electric Arc Lamp. James J. Walsh, Paris, Texas. Application filed July 29, 1896.



NO. 585,699.

A feed regulator for a carbon-carrying rod of an arc lamp is described, comprising a pair of escapement wheels arranged on one shaft, the teeth of one wheel alternating with those of the other, and pendulum-governed escapement dogs alternately coacting with the escapement wheels, the dogs being mounted to swing independently one of the other.

585,731. Telegraph Switch. James S. Allen, Halsey, Neb. Application filed July 25, 1896.

Contact pins, a spring-pressed plate and a cut-out plug are essential features. The plug has centrally grooved contact strips, and is adapted for insertion between the spring-pressed plate and the pins, and the plate serving to retain the plug and hold it so that the pins will lie in the grooves of the contact strips.

585,733. Railway Signaling System. Henry Bezer, New Rochelle, N. Y. Application filed April 22, 1895.

A series of signals is arranged in blocks, and circuit controllers are controlled by the operation of each intermediate signal of each overlapping group of three signals and controlling the circuits of the end signals of such group, whereby such intermediate signal locks such end signals at "danger" when it fails to go to "danger" behind a train.

585,760. Electric Motor for Elevators. John D. Ihlder, Yonkers, N. Y. Application filed August 11, 1896.

In an electric motor in which the current through the armature is reversed there is a series field in sections, one section of which is reversed with the reversing of the armature.

585,772. Electric Controller. Alexander F. Macdonald, Schenectady, N. Y. Application filed January 5, 1897.

A contact cylinder is provided with contacts mounted on the outer periphery of the drum, contacts mounted on the inner periphery, stationary brushes engaging with the outer peripheral contacts, and stationary brushes engaging with the inner peripheral contacts.

585,853. Secondary Battery. Izak Samuels, New York, N. Y. Application filed August 11, 1896.

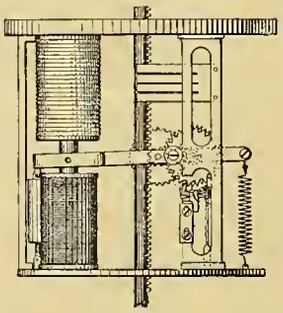
The element comprises a plate of active material, a terminal embedded therein, a telescopic case of conducting material inclosing the plate, and a telescopic case of non-conducting material inclosing the conducting case.

585,854. Galvanic Battery. James Sully, New York, N. Y. Application filed October 27, 1896.

This cell is composed of a negative, porous, gas-coke, carbon, cylindrical-containing vessel rendered sufficiently dense on its external surface to prevent the passage onto its surface of an electrolytic fluid without destroying the porosity of the surface of the vessel or its inner porosity, and a positive zinc pencil immersed in an electrolytic fluid of carbonate of potash and kerosene oil contained within the carbon vessel, and resting in a small quantity of quicksilver contained within an insulation in the bottom of the vessel.

585,855. Galvanic Battery. James Sully, New York, N. Y. Application filed February 16, 1897.

In this cell a positive electrode of carbon has pressed against or fastened to its lower end a section of an easily oxidizable metal, notably aluminum or zinc.



NO. 585,726.

585,863. Armored Electrical Conduit. Edwin T. Greenfield, Brooklyn, N. Y. Application filed October 7, 1896.

A conduit having an external metallic armor, an internal tube or lining of insulating material and an interposed layer of fibrous material which is impervious to moisture.

585 864. Armored Electrical Conduit. Edwin T. Greenfield, New York, N. Y. Application filed December 10, 1896.

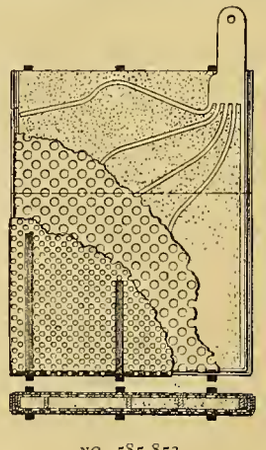
This conduit tube is composed of a metal armor and an interior lining of oil-cloth, with the painted surface thereof adhering to the inner wall of the armor.

585,872. Brush-holder for Dynamo-electric Machines. Robert Lundell, Brooklyn, N. Y. Application filed July 11, 1896.

A commutator brush-holder is described, consisting of a stationary part and a movable part adapted to exert a pressure upon the brush in two directions, in combination with adjustable means connecting the movable part with the stationary part, whereby the pressure may be varied as desired.

585,892. Electricity Meter. Alwyn W. Staveley, Isaac H. Parsons and Thomas J. Murday, Leicester, England. Application filed January 5, 1897.

This device is for recording at regular intervals the indications of an ammeter or wattmeter and computing the results, and it comprises an electrically driven pendulum, in combination with a trip contact-piece which only completes the circuit of the operating electro-magnet when the arc of oscillation of the pendulum falls below a certain length, thus insuring correct timekeeping under variable loads.



NO. 585,853.

585,896. Telephone Transmitter. Ernest C. Wilcox and Burton L. Lawton, Meriden, Conn. Application filed August 31, 1896.

A carbon conducting diaphragm is interposed between the body and cap, and an annular elastic conducting washer bowed flatwise to produce a plurality of contact points, and arranged between the body and cap so as to make a plurality of engagements with the diaphragm, whereby the same is firmly held in place, but not so closely as to interfere with its vibration.

585,904. Automatic Cut-out. Charles N. Black, New Haven, Conn. Application filed March 15, 1897.

The combination with a dynamo-electric machine having two or more independent armature circuits of two or more independent lamp circuits connected in series with and between the independent armature circuits of the machine, and automatic cut-outs corresponding in number to the independent lamp circuits which they are placed across, and each providing a non-inductive path and operating to instantaneously short-circuit the respective lamp circuits when the voltage thereto exceeds a predetermined safe working limit.

585,915. Operator's Switch for Telephone Exchanges. Louis Johnston, La Crosse, Wis. Application filed March 13, 1897.

A reciprocating circuit-changing cam is provided on its under side at opposite sides of its longitudinal center with alternately arranged projections and depressions, and there are two longitudinally aligned series of pairs of contact springs under the cam and in the path of its two sets of projections and depressions.

585,937. Electro-magnetic and Mechanical Brake. John E. Parker, Bayonne, N. J. Application filed December 17, 1895.

An electro-magnetic brake-bar and blocks are placed horizontally in juxtaposition to car-wheels, and a metal frame supporting the bar and blocks, engaging with a shaft placed transversely across the car and having a screw-thread at each extremity, and controlled by hand by means of a sprocket cylinder and sprocket chains, causing the brake-block to advance or retreat in respect to the inner surface of the car-wheels.

585,959. Apparatus for Electrolytical Decomposition of Salt Solutions. Carl Kellner, Vienna, Austria-Hungary. Application filed February 24, 1896. Patented in Germany September 23, 1893; in Switzerland October 17, 1893; in France October 17, 1893; in Belgium October 17, 1893; in England October 17, 1893; in Norway October 17, 1893; in Italy December 31, 1893, and in Austria-Hungary March 22, 1894.

In apparatus for the electrolytic decomposition of common salt for the purpose of producing bleaching agents electrodes are provided, consisting of a group of interspaced plates having one of their surfaces platinized and the other amalgamated, the plates rigidly connected by non-conductive connections passing through the plates, the opposite surfaces of each plate forming an anode and a cathode respectively, and electric conductors respectively connected with the platinized and amalgamated faces of the first and last plates of the group.

NO. 585,863.

586,014. Sand-box for Electric Cars or Snow-plows. Edward C. Collins, Taunton, Mass. Application filed March 15, 1897.

In a track-sanding device for electric cars the combination is described of a sand-holding receptacle having a semi-circular bottom and a discharge orifice in the bottom, an oscillating valve located beneath the receptacle and arranged to normally close the orifice, means for moving the valve in an arc of a circle to open it by a pressure imparted by the operator, and a spring for closing the same.

586,029. Electric Switch. Frank D. Hall, Syracuse, N. Y. Application filed March 8, 1897.

The first claim is given: The combination with the insulating base and a plurality of poles secured to said base and disposed in pairs, of a tubular post projecting from the base between the pairs of poles, a plunger guided rectilinearly in said post, switch-plates carried by said plunger permanently parallel with the respective pairs of poles, a lever fulcrumed in the post, an eccentrically curved cam fixed to said lever and bearing on the end of the plunger to force the same toward the base, means for locking the lever to retain the switch-plates in contact with the poles, and a spring in the base of the post forcing said plunger outward.

586,044. Electric Storage or Secondary Battery. Frank King, London, England. Application filed January 26, 1897.

A secondary battery element consisting of a plate or support having perforations therethrough containing active material or material to be rendered active, and having applied to the sides thereof an adherent coating or membrane of india rubber, perforations being made through the rubber and through the active material, so that the electrolyte may have access to the active material through the perforations, the faces of the plate being protected from contact with the electrolyte by the adherent coating of rubber.

586,055. Manufacture of Incandescent Lamps. Johan W. Th. Oláu, New York, N. Y. Application filed March 13, 1893.

An incandescent electric lamp having an incandescing body whose ends are electro-plated with a non-oxidizable metal.

586,075. Electric Switch. Eustace Oxley, Washing- D. C. Application filed April 23, 1897.

In a balanced system of electrical distribution there is the combination with the balancing wire, of a switch normally closed against spring pressure, and completing the circuit upon all sides of the system, an electro-magnet having a winding of comparatively high resistance connected to the opposite sides of the fuse of the balancing wire, and an armature for the magnet connected to a device which mechanically locks the switch in its closed or "on" position.

Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, JULY 24, 1897. No. 4

Illumination of Niagara Falls.

By Orrin E. Dunlap.

For the second time in their history the falls of Niagara are to be seen at night under artificial light. The first time this spectacle was presented to the public was in 1879, and the light used was electricity. Now it is proposed to use a light which at that time was unknown, and this is acetylene gas. This is the first public demonstration of the illuminating powers of acetylene that has been made, and for this reason it is attracting considerable attention. The display is being made by the Acetylene Light, Heat & Power company, of which Joseph Devine is manager. The plant in use was hurriedly installed in order that the illumination might be in operation for the entertainment of the Pan-American party on their recent visit to the Falls. For this reason the equipment is not so complete as it might have been had more time been given.

The plant installed for this special purpose consists of three Naphey automatic generators, each of 250 pounds capacity. One of these generators has been placed in a small room in the inclined railway building, one in the old park office at the lower gate, and the third in a building on Bath Island. From these generators so placed half-inch pipe runs to 15 large locomotive headlights placed in various positions. Six of these headlights have been set on the piers of the bridge leading to Goat Island, and as they are below the bridge floor they are out of sight. Others have been set on temporary stands in Prospect Park, while others are located on the debris slope beneath the high bank at the foot of the American fall. Eleven of the headlights have seven Naphey burners, while the remaining four have five burners apiece. The burners are the half-foot style. The lamps on Goat Island bridge are intended to light up the upper rapids, and three of them cast their light up stream, while three others send their rays across the dancing waves as they speed downward past the bridge toward the brink of the American fall. The lights in Prospect Park send their rays across toward those beauty spots known as Goat and Luna islands, and also light the way for the waters to make the plunge over the precipice of the American fall. Down below the lights gleam through the spray cloud as it floats out from the foot of the fall and light up its whiteness in a pleasing way. No effort is being made to light up the Horseshoe fall, but all efforts are confined to the river close to the American shore. The pipe that runs from the generators to the lamps is carefully concealed beneath the sod. The expanse of the water between the islands and mainland is so great that the lights do not appear to penetrate to any great distance, but this is said to be due to the lack of proper apparatus rather than to the gas, for it is contended that the acetylene light is white and extremely brilliant.

Fig. 1. View up the River from Prospect Park. Fig. 2. Brink of the American Fall, Horseshoe Fall in the Distance. Fig. 3. Goat Island Bridge.

ILLUMINATION OF NIAGARA FALLS.

In the accompanying illustrations three excellent views of the portion of the river thus lighted are presented. Fig. 1 shows the Goat Island bridge from which the principal illumination is made. In Fig. 2 is to be seen one of the lamps standing close to Prospect Point, and in Fig. 3 one of the lamps is to be seen casting its beams on the brink of the American fall, with the Horseshoe fall in the distance. Fig. 4 on page 44 shows one of the generators employed in the illumination.

Years ago, when the falls were illuminated by electricity, Prospect Park was owned by a private company, whose enterprise led it to purchase a Brush machine. The first equipment was not large enough, and it was exchanged for one of greater capacity. The effect of the light on the falls was such as to excite surprising interest, for the electric light was then more of a novelty than it is to-day. Night after night Prospect Park was crowded to the utmost with excursionists who came to see the illumination, In one summer over 150 evening excursions were run to the falls, and the receipts of the Park company were increased over 20 per cent. One night the rays of the lights were temporarily diverted from the falls and directed toward the crowded porches of the Clifton House on the Canadian side of the river. When the light fell on them the people in the throng arose as a single person and sent cheers and greetings floating across the boundary gorge to the American side.

The enthusiasm over the lights on the falls at that time was great, and the fountains in the park were truly beautiful. But when the state of New York purchased the lands about the falls for free park purposes, the artificial effects were discontinued, much to the regret of residents and visitors to the Falls. It is understood that the acetylene illumination will be continued throughout the summer.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the Western Electrician.]

Arrangements will probably be made with the Clearfield & Mt. Ayr Telephone company to establish a local exchange in Mt. Ayr, Ia.

The farmers who contested the advance of the Northwestern Telephone Exchange company, in the vicinity of Yankton, S. D., have been awarded an average of damages of 85 cents per pole by condemnation proceedings.

The Interstate Telephone company has just purchased a 100 drop switchboard for the Edgemont, S. D., exchange. This company is within 20 miles of Newcastle, Wyo., with its lines and will extend to that place, Crawford and Hot Springs.

The handsome new building of the Rocky Mountain Bell Telephone company in Helena, Mont., is approaching completion.

A telephone line has been built from Moravia to Iconium, Ia.

The Commercial Telephone company of Tama, Ia., having failed to pay expenses at the present rates, has

notified patrons that rates will be advanced 25 cents per month.

The Harrison Telephone company has connected with Spearfish, S. D.

A Minneapolis paper charges that the obstacles which the Council has placed in the way of the independent telephone companies which have been seeking a franchise, have been instigated by the Bell Telephone company. The Minneapolis Council has not a very savory reputation, and such a charge is not hard to believe. The Mississippi Valley Telephone company submitted to the demand for a gross earnings tax, although the city attorney said that such a tax could not be levied on the present company, and to many other amendments, but balked entirely at the demand that the company's books be open to aldermanic inspection in order to ascertain the gross earnings tax.

Long-distance Telephone Business.

"We don't build telephone lines altogether on the principle that railroads are built," said Manager Brooks of the American Telephone & Telegraph company to a writer in the *Chicago Record*. "Sometimes a big city, with the finest imaginable country around it, isn't worth anything to us.

"Take Bloomington, for instance, right here in our own state. It has about 25,000 population, and it scarcely pays us to keep our office there. It is in the richest section of Illinois, so far as agriculture is concerned, but it is not a factory town, and we get more telephone business from Kankakee.

"All during the late fall, winter and early spring, Madison, Wis., is one of our dead letters. But it wakes up in the resort season, and the wires are kept red hot. Lake Geneva, Delavan, Oconomowoc, Waukesha, Edgerton and a score of other black dots on the Wisconsin map make business for us in summer and die to nothing

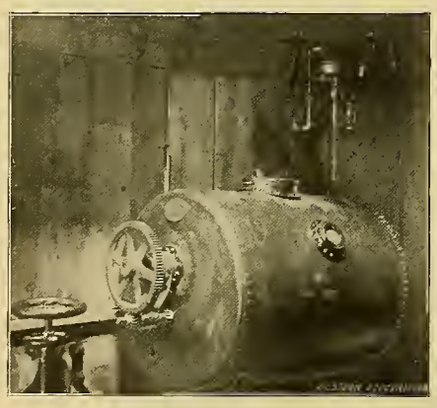


FIG. 4 ILLUMINATION OF NIAGARA FALLS.—GENERATOR.

in the winter. So many families are divided in the summer, with husbands, brothers and sweethearts at home in Chicago, that letter-writing won't wholly suffice. It costs comparatively little for a five-minute conversation, and many men avail themselves of it simply to hear the voices of friends and relations.

"Milwaukee is on one of the busiest circuits out of Chicago. There is an immense amount of business done over the wires between these cities. As the smaller city, too, Milwaukee sends more messages to Chicago than Chicago sends to Milwaukee. In the routine of trade this is natural, as Milwaukee depends more upon Chicago than Chicago does upon Milwaukee.

"During the sessions of the Legislature the wires between Springfield and Chicago do a heavy business. Very few people realize Chicago's interest in legislative bills. When the Humphrey bills were up last spring calls from Chicago citizens averaged about fifty a day. Persons of every degree used the wires for calling up legislative members and lobbyists.

"The map of the American Telephone company, with a chart of its calls, will locate industries of the country and the interests which bind them to another section.

"For instance, from Cleveland and from Pittsburg the telephone calls between these places show their relations in the iron industry. Practically all of the iron ore of the north country is shipped to Cleveland, for final manufacture at Pittsburg.

"At certain seasons of the year one of our busiest lines is the great stretch of wire between Memphis, Tenn., and Providence, R. I. Nine-tenths of the calls from Memphis in this season are for Providence, thus indicating the territory to which the southern cotton crop moves for milling.

"In like manner the calls for Chicago from the pine woods of Wisconsin, show where the products of the woods find a market.

"So it isn't the size of the city or the population of its surrounding country that indicates telephone business. Trade is our telephone barometer, and in mapping new lines the intent is to forestall trade interests."

The Board of Aldermen of St. Paul proposes to permit the Selby avenue hill to be tunneled by the street car company in order that the cable may be changed to electric power.

Design and Construction of Electric Power Plants.

By Bion J. Arnold, M. S.

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Part X.

Preliminary Determinations.

Before the actual design of an electric power plant is undertaken in any particular case, it is quite necessary for the engineer in charge of the work to acquaint himself with all the conditions which are likely to have any bearing on the result. From what has already been said of the individual parts which enter into the make-up of a completed station, it is evident that no fixed set of rules can be given for the design of a power plant, nor can the variable conditions which must be considered be expressed by the terms of a formula. In proportion as the designer of a plant grasps the situation and gives to each influencing condition its relative value, will he be successful in his work.

Unfortunately, it is not always simply a problem of giving values to physical conditions which confronts the engineer. Frequently he is called upon to use the utmost tact and skilled judgment in handling men. One of the first things he must know is the character of the men with whom he is to be associated and his exact position in relation to the enterprise. Are the persons furnishing the money willing to invest all the capital which can be made to pay a reasonable return, or is there a limited amount of money available with which the best results possible are expected? Is the engineer to have complete charge of the design, or must he make his own judgment co-ordinate with the preconceived ideas of his employers? If the engineer is given practically unlimited capital and allowed the free use of his own judgment, then the situation is all that can be desired, and a power station ought to be designed which will give the greatest returns for each dollar invested. But, on the other hand, if the designer of the plant is hampered from lack of money it devolves upon him to make the best showing possible with the capital at hand; and it will require fully as good judgment to decide when a particular part of the equipment of the plant can be cheapened or even dispensed with as to determine whether the investment in a certain auxiliary is justified by the advantages to be gained.

The engineer may find in some cases that there is not only a lack of available funds, but also that he is expected to work along lines dictated by others. It is here that he is called upon to influence men as well as to manipulate figures, for by changing the prejudice of the investors, or showing the necessity of securing a larger appropriation, he may make a comparative success out of what would have otherwise proved a failure. Circumstances may dictate the acceptance of ideas antagonistic to those of the engineer. In this case, if the designer cannot satisfy himself that these ideas are correct, or equally as good as his own, he should resign his commission. If he elect to proceed with the work, he should be as conscientious in his calculations as he would have been had the conditions promised results which would have added to his professional reputation. It must be remembered that it is not always the most efficient plants that prove to be the best investments, as the conditions under which the electrical energy is distributed and used often determine whether the enterprise is a profitable one or not. It can easily be conceived that the most efficient power plant located in an unfavorable district would prove to be a poor investment, whereas an uneconomical plant, if in a more favorable locality, would prove profitable. The designer of a power plant must early decide the policy which he is to pursue in connection with those who have employed his services and determine whether his position requires him to make this or that suggestion, and when he is convinced that an electric plant will not pay he should not hesitate to advise against its installation.

The technical part of the problem will, of course, begin with the determination of the character of the load. Will the current generated be used for lighting, for power, or for some of the other purposes to which it is being applied every day, or will the plant be expected to furnish energy for a variety of services? Where is the demand for current located? What methods are to be adopted for its distribution? What will be the efficiency of the system? What will be the actual load upon the power plant? How will it vary? These are all questions which must be determined before the actual work of design is begun, and though their consideration involves problems of the distribution, rather than of the generation, of electrical energy, yet their influence upon the design of the power plant must be thoroughly understood.

Naturally, the amount of load upon the station for each class of service must be determined, and in any investigation along this line it is important to keep in mind future exigencies as well as present needs. Too many stations have been designed without due allowance for even natural growth, while in others, in which some provision was originally made for an added demand, the use of current increased to an extent so much greater than the investors contemplated that the original plant was soon seen to be inadequate and a new station found necessary. It is well, therefore, to estimate the probable, as well as to determine the immediate, demand. If an old power station is to be rebuilt, the problem of the amount of power is comparatively more simple than when a new district is to be invaded, as the output of the old station furnishes a basis for an estimate.

Obviously, the least possible amount of machinery in any particular case will be that necessary to supply the greatest demand that will likely be made upon the station within a reasonable length of time, as enough equipment must be provided to carry the peak of the heaviest load. The time and amount of this largest demand are determined, evidently, by local conditions. In a lighting system, for instance, it will probably be during the darkest days of the year, which usually coincide with the holiday season. The number of lamps wired in on the system will furnish a basis for an estimate, though it will be necessary to approximate the percentage of total lamps used at the time of maximum demand. Records in some cases show that this percentage runs as high as 50 per cent., but in ordinary central station lighting work it will be safe to allow as low as 35 per cent. This applies, of course, to incandescent lamps. In an arc

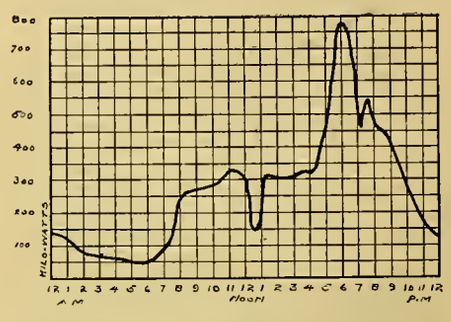

FIG. 60. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—LOAD LINE OF INCANDESCENT LIGHT AND POWER SYSTEM.

system the maximum lamps required will be much greater than 50 per cent. of the total, and will approximate in many cases to nearly or quite the entire number of lamps connected. Power circuits are uncertain, but in most cases less than 25 per cent. of the horse power connected can be taken as a maximum demand. But it is upon railway circuits that the determination of the maximum load presents the greatest difficulty, for just when the greatest travel will occur and how much it will be are questions which are as difficult of solution as they are important to pre-determine. The number and weight of the cars, the number and per cent. of the grades, the maximum and average speeds, the probable average and maximum number of passengers carried, are all factors which enter more or less into the result, but which cannot be discussed in detail at this time. Fortunately, however, the exact determination of the minimum amount of machinery actually required to do the work will seldom be required, as the necessity of providing a reserve equipment, both for breakdowns and growing demand, will dictate the erection of a power plant sufficient for all immediate purposes.

Closely associated with the determination of the actual load on the station will be the questions of the location of the plant and the system of distribution. In fact, these three questions are so intimately connected that it will be impossible to decide questions involving one without taking into account the influence of the other two. Two load lines, one showing the actual demand supplied and the other the actual load upon the station, might appear very different. For instance, if a system of storage battery sub-stations be adopted for the distribution of the energy, we can understand how the load line of the power station might approximate toward a straight line, representing a steady load, while at the same time a load line constructed by combining the output of the various sub-stations would display the peculiarities of most load curves, having the usual peak and also a period of small demand. Even if no batteries are used and the output of the station follows closely the

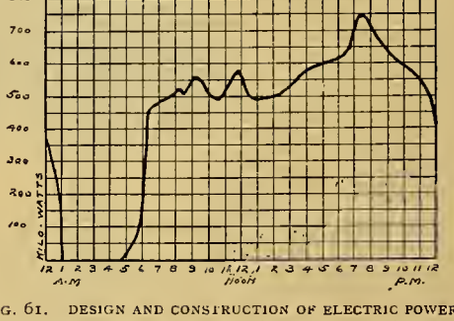

FIG. 61. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—LOAD LINE OF ELECTRIC RAILWAY SYSTEM.

variations and even fluctuations of demand, the load upon the station will be greater than the energy actually used by the amount lost in transmission. This transmission loss will depend upon the system adopted and also with any given system upon the location of the station, and thus the questions of amount of load, location of power plant and system of distribution go hand in hand.

It is not my intention, at this point, to take up the question of the distribution of electrical energy or add anything here to the discussions of alternating versus direct currents, high-tension versus low-tension, series arcs versus constant potential arcs, polyphase versus single phase, etc. These questions are of the most vital importance and must be settled before the design of the

power plant is undertaken, but it will suit our present purpose to consider them as settled.

In certain cases the adoption of the system may do much in determining the location of the plant, whereas, on the other hand, the location of the plant may predetermine the character of the distributing system. When, however, peculiar advantages do not render the problem an easy one it may take the very best business and engineering judgment to settle the complicated question.

The ideal location for a steam plant is one where the cost of real estate is a minimum, where plenty of room is available for extensions, where the insurance rates will not be excessive, where there will be no trouble in securing good foundations, where the coal supply can be handled easily and cheaply, which is near an abundant supply of water, and, finally, which is near the center of distribution of the district or system to be supplied with light or power.

It will be found that few locations possess all these advantages, and in the choice between a number of available sites it becomes a question of cost in deciding which of the desirable features can best be sacrificed.

To determine the "center of distribution" it will be found desirable to locate approximately, say upon a map, the probable demand at different points, and then determine the "center of gravity" of these various points, taking into consideration, of course, the amount of energy demanded at each point. In a railroad system this becomes a simple matter, as the load upon different branches or upon separate sections of the road can be estimated; these loads can then be considered as concentrated at the middle points of the branches or sections, and the "center of gravity" determined. In this determination the future demands must constantly be kept in mind. It will seldom be found, however, that this center of distribution possesses any of the other desirable advantages of an ideal location for a power plant. In a lighting system it will generally be found in the heart of the business district, removed from a convenient supply of water and coal, and in a locality where the real estate is expensive, whereas in an electric railway system it may fall in the center of a desirable residence portion of the city, where a power house would not be tolerated. The importance of locating the power house at or near the center of demand is of course more serious with a low-tension system of direct current distribution than where a high-tension alternating current

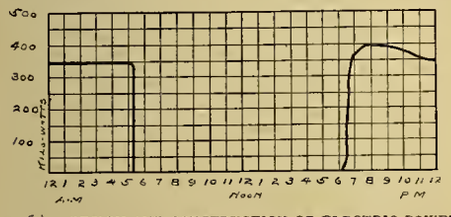

FIG. 62. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—LOAD LINE OF SERIES ARC SYSTEM.

is used. If the series arc system is the only one to be considered, the question immediately loses its importance, as it is immaterial with an arc circuit at which point on its periphery it receives its supply. But in a parallel system of distribution over low-potential mains the extra investment in copper necessary if the power plant is located at some other point than at the center of demand may become a serious matter. The weight of copper required to transmit a given amount of power with a certain percentage of loss between two points varies as the square of the distance between the points, so that as the station is removed away from the electrical center of gravity the amount of conductor material required increases very rapidly, and in each particular case where it is possible to locate the station at the center of the system the advantage gained by the choice of some other site must justify the extra investment in the line. Such advantages would be, for instance, the economical handling of the fuel supply. This will generally require that the station be located upon a line of transportation, either rail or water, where the coal can be transferred to the floor of the boiler room or by means of conveyers to storage bins. Such a location will also offer convenient facilities for the disposition of the ashes.

An advantage which will outweigh the investment in a large quantity of conductor material will be gained by locating the station within a convenient distance of a supply of water sufficient for condenser purposes.

Saving in the items of cost of real estate or of insurance or the possibility of obtaining suitable foundations may be sufficient in themselves to determine the location. In fact no general law can be laid down. In considering a number of locations for a given plant the question can be settled by estimating the amount of first investment required and also the operating expenses for a year in each case. A comparison of these results will indicate which location is the more desirable.

The amount of load, the location of the plant and the distribution system once decided upon, the next point in the problem is the selection of the size of the units. To make this selection successfully, it may be well to lay out the estimated load line for each class of service. It will usually be a good plan to lay out two load lines for each case—one representing the maximum expected demand and the other the probable minimum, as this will give a very fair idea of the conditions under which the station is to operate. A set of load curves is shown in Figs. 60, 61, 62 and 63. Fig. 60 shows a typical diagram of an incandescent light and power system, the drop in the day load being caused by the shutting down of the motors in a manufacturing district during the noon hour. Fig. 61 is the load diagram of an electric railroad having a very high load factor while in operation, caused partly by not running the road between the hours of 1 and 5 A. M. Fig. 62 is a typical diagram of an arc circuit and shows the peculiarity of a practically steady load which has already been pointed out. Fig. 63 is a load curve obtained by combining the diagrams of Figs. 60, 61 and 62. To the knowledge of the load to be expected, gained by a study of these diagrams, the engineer must add considerable judgment of what is likely to happen, for it is extremely important that in selecting the size and number of units he should make provision for every possible exigency. The principles to be borne in mind are:

First—Choose the size of the units so that those in operation at any one time will be running at full capacity.

Second—The number and size of the power units should be such that there is always a reserve in case of a breakdown of any one unit.

Third—Wherever possible choose standard sized units.

By the term "unit," as applied to the generating set, is meant the engine and dynamo combined, considered as one single piece of machinery. If one engine drives two or more generators, the entire set is to be regarded as one unit. While considering this phase of the subject, it is well to take into account the peculiarities of the efficiencies and conditions of operation of both the engines and dynamos. It will be remembered that an electrical generator will operate at satisfactory efficiency between 75 per cent. of its rated output and 50 per cent. overload, but unfortunately the steam engine by which it is driven has a sharper economy curve and its efficiency drops off more rapidly as its output departs from its rated capacity in either direction. (See Part V., WESTERN ELECTRICIAN, May 15, 1897.) The desirability of operating the engines, then, at their full rated output is by this time well understood. But with a constantly varying load this cannot be done. The only thing left is to proportion the capacity of the generator part of the unit for a greater output than the engine part, selecting the size of the engine to correspond to the average demand. The generator rating is a question of heat limit, while the engine rating is a question of economy. An overload on the generator, then, may result in an injury to the armature, while a corresponding overload on the engine will only result in a greater consumption of water per delivered horse power, providing, of course, that the working parts of the engine are designed of ample strength to withstand the strain. The best combination, then, will be a generator of such rating that it will not heat excessively at a load corresponding to the outside limit of power of the engine and an engine of such rating that it will be operating at its most economical point of cut-off during the greatest possible length of time during its period of operation. It may be comparatively easy to proportion the size of the units according to these principles if successive daily loads upon the plant are similar, but when the output varies with the weather and the seasons, as in a commercial lighting plant, or is liable to excessive demands, as with an electric railway, the selection of the proper units may prove to be a very troublesome question, and one in which all possible information pertaining to the environment and conditions surrounding the plant will be found useful.

It may be instructive to take up the case of the load diagrams already shown. These diagrams are plotted from the readings of the output of a large modern central station and therefore are not ideal. In this station the load shown in Fig. 60 was provided for by two 400 kilowatt generators. With the present load, units of this size cannot fail to be uneconomical, as the generators will be running underload most of the time, and further no allowance is made for reserve capacity. Future growth will probably justify the selection of the larger units, but if it were a question of the most economical installation and operation at the present time it will be seen from the diagram that three 300 kilowatt units and one 100 kilowatt unit would have been better and more reliable. It will be noticed that this diagram, having a sharp peak, a long period of small demand and a sudden shutting off of the demand for an hour during the middle of the day, indicates an ideal case for the use of a storage battery auxiliary.

The load given in Fig. 61 is carried by four 450 kilowatt generators. This is certainly a large allowance for reserve capacity, but is evidently not a selection which allows for economical operation with the load given. One 600 kilowatt unit would handle the load shown with success, while two such units would provide a reserve in case of breakdown. In case of growth an additional unit of 300 or 400 kilowatts capacity would allow an economical manipulation. The tendency at present is toward adopting a small number of large units rather than having a large number of small units, as was formerly practiced, and a favorite arrangement is to select duplicate units in two sizes, one size usually twice that of the other. Generators having a capacity of 1,600 kilowatts are not uncommon, so that the designer of a power plant has a wide range of sizes from which to choose. There is danger, however, in installing large units of not making adequate provision for economical operation during the period of light load, which generally covers a considerable period of the day.

In providing for the arc lighting load usual practice has been to install a line shaft to which are belted the various dynamos, ranging in capacity from 25 to 125 lights each, though in some cases the generators are belted directly to the engine flywheels in sets of twos or fours. If the former system is adopted two engines are, as a rule, installed, either of which can drive the total load, leaving one in reserve. If the second system is followed, the size of the unit is determined according to the principles already laid down. As indicated in the lecture on generators (Part VIII.), arc dynamos are now being made in larger sizes and suitable for direct connection, and it will not be long before the complicated and unsightly system of counter-shafting and belting can be done away with, and our arc lighting stations will assume as neat an appearance as our modern railways plants.

The size of the generating units disposed of, it will be necessary next to determine upon the boiler units, and this is done by considering the composite load line of the plant, as shown in Fig. 63. It is generally found desirable to set the boilers in batteries of two each, and where convenient a battery of boilers should be considered as a single unit. In small plants a very convenient arrangement will be to have three batteries so proportioned that any two will handle the maximum load, leaving one in reserve for cleaning and repairs. In some plants the plan is sometimes adopted of having a complete duplicate plant of boilers, firing one set at one time and the other set at another, thus working them alternately. This seems to be a waste of money, for by providing much less reserve capacity successful and reliable operation can be secured. As in the generating units, the larger sized boilers are preferable to the smaller sizes, both for fuel economy and for the labor account.

Knowledge of the conditions of water supply are necessary in choosing the kind of boilers, for in certain cases it is preferable to install boilers which are easily accessible for cleaning, rather than to provide elaborate equipment for the purification of the water. General laws derived from particular experiences will be found of little use in making the preliminary determinations for each particular case, and, as remarked in opening, the careful engineer will adopt plans only after the most

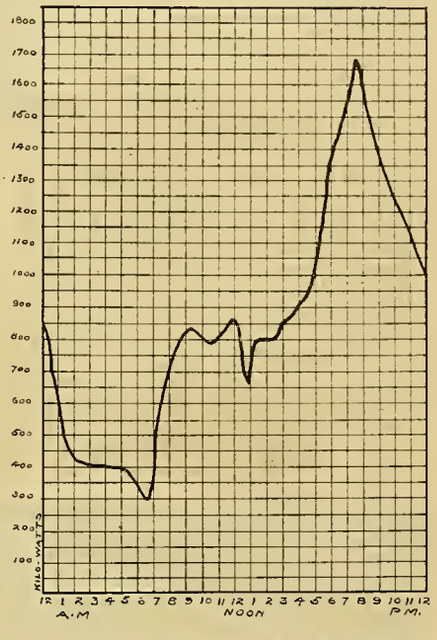

FIG. 63. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—COMBINED LOAD CURVE OF ENTIRE PLANT.

comprehensive study of the surrounding conditions, and the results will depend upon his skill and judgment.

[The next lecture is the last of the series. It is entitled "Buildings and General Arrangements."]

Electrical Business Maxims.

An electrical company in Buffalo has compiled these "Electrical Don'ts." Some good advice is tersely expressed:

Don't try to revolutionize the electrical business by cutting prices. You can't.

Don't expect to get all the jobs you figure on and get mad if you don't.

Don't expect to make a living on a 10 per cent. margin of profit. You can't.

Don't abuse your competitor because he underbid you. He may lose money and yet do as good work as you.

Don't bid low, do poor work and employ boys to even up. You can't.

Don't educate the embryo electrician and then try to kill him off as soon as he is able to work.

Don't fail to keep your credit good. You must get a fair price for your work or you can't.

Don't—with a big D—think you are the whole push. There are others.

Don't give your work away. What is worth doing is worth getting paid for; and, above all, employ good workmen.

The Michigan Telephone company has declared and paid a quarterly dividend of 1½ per cent. for the quarter ended June 30th. This announcement has especial interest from the fact that the Bell people have been meeting competition in Michigan.

Utilization of Water Power Electrically Transmitted to Ansonia, Conn.

The economy and advantages of utilizing power generated at a waterfall and electrically transmitted to a factory or other point where it is to be employed in driving motors or furnishing light are well illustrated in the plant of the Farrel Foundry & Machine company of Ansonia, Conn., where the heavy machinery is driven by motors operated by electricity transmitted from a power plant three miles distant. Previous to the development of the water power the generating plant of the Farrel Foundry & Machine company consisted of two 75 kilowatt, six-pole, 275 revolution, 500 volt dynamos directly coupled to 100 horse power Ames engines, and one four-pole 65 kilowatt 220 volt generator driven by belt. The latter still furnishes current to three traveling cranes, and the others are held in reserve, being used only during a short space of the year to drive the motors scattered throughout the shops. The power station of the Farrel company is illustrated in Fig. 1. This plant was purchased before the Derby Gas company arranged with the Farrel Foundry & Machine company to supply current from the power station at the Housatonic dam, where it utilizes the excess water flowing over the dam. The Derby company having two four-pole, 200 kilowatt, 550 volt machines, and being thus in a position to supply power, made a favorable arrangement with the Farrel company.

Both dynamos are direct current machines, and as the length of the transmission is nearly three miles, they are coupled in series to secure the necessary pressure, and deliver current at the brushes at 1,100 volts. At the switchboard at Ansonia the pressure is 1,000 volts. The distribution is carried out on the Edison three-wire system, and as half the motors in the works are connected to each side of the system, the working pressure of each motor is 500 volts.

In the engine room at Ansonia is a switchboard of the panel type, shown in Fig. 2, arranged not only for the complete control of the motor plant operated from Derby, but also for the isolated plant of the Farrel company. The two 75 kilowatt generators in the Farrel works are used for about two months only in the year, the current from the Housatonic dam being used for the other 10 months. The first two panels control the two 75 kilowatt generators; the third is an outside supply panel, and then come 10 panels, each controlling two motors. Each panel carries two motor automatic starting rheostats, with magnetic cut-out, four single-pole double-throw switches, so connected that any motor may be thrown on either side of the three-wire system. An ammeter is in circuit with each motor. The last panel but one on the left is the feeder panel for the three traveling cranes, while the last panel is the generator panel for the 65 kilowatt 220 volt generator supplying current to the cranes.

The motor equipment consists in all of 19 motors of the following horse power and speed: Three of 35 horse power each at 525 revolutions; five of 10 horse power each at 325 revolutions, and five of 15 horse power each at 312 revolutions. They are all of the four-pole type, and for the most part are located directly over the floor of the shop on platforms suspended from the roof girders. From these the belts are taken to the shafting below, whence the various machines are driven. The illustration (Fig 3) shows six motors set on platforms in the new machine shop. They range in capacity from 10 to 35 horse power. Directly beneath them is the path of one of the traveling cranes. Other motors are attached to the wall, and a few are on the main floor near the walls.

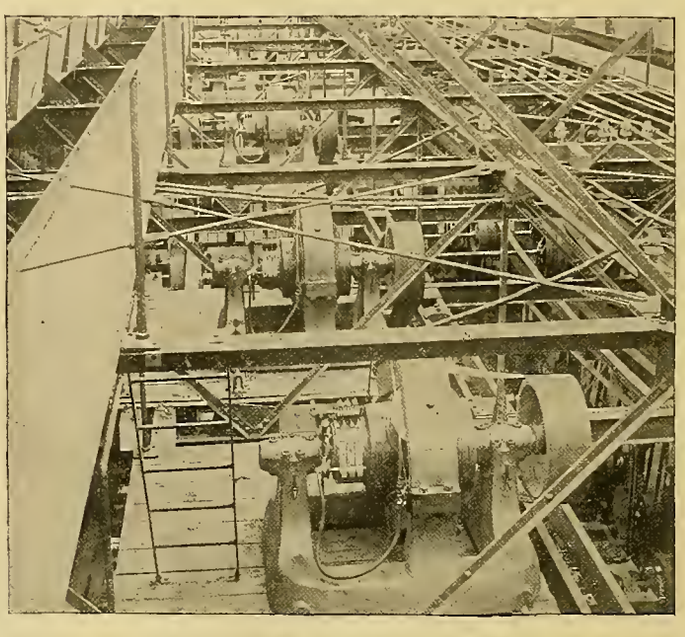

FIG. 3. UTILIZATION OF WATER POWER ELECTRICALLY TRANSMITTED TO ANSONIA, CONN.—SIX 500-VOLT MOTORS ATTACHED TO ROOF GIRDERS IN NEW MACHINE SHOP, FARREL FOUNDRY & MACHINE COMPANY, ANSONIA, CONN.

The machinery manufactured by the Farrel Foundry & Machine company is of a peculiarly heavy type and the machines driven by the motors are of various characters and sizes, subjected to sudden, heavy and fluctuating loads, yet, according to the officers of the Farrel company, the plant, running since October, 1895, has not only given complete satisfaction, but no repairs either to generators or motors have been found necessary during the 18 months in which the electrical system has been in operation.

The economy induced by the introduction of the electric motors is perhaps best illustrated by the result obtained in the roll shop. This was previously run by a 250 horse power Buckeye engine, usually loaded to its full capacity. The same rolling machinery, as well as a variety of other machinery, is now driven by motors taking a total power of from 125 to 150 horse power.

The 65 kilowatt 250 volt generator supplies the current to operate three traveling cranes and several jib cranes. The machine is also subjected to very wide fluctuations of load, sometimes extremely severe. Under service of this character the ordinary generator might be expected to give some dissatisfaction, yet it operates without the least sparking and without the necessity of changing the brushes under any change of load. The entire electrical plant was furnished by the General Electric company of Schenectady.

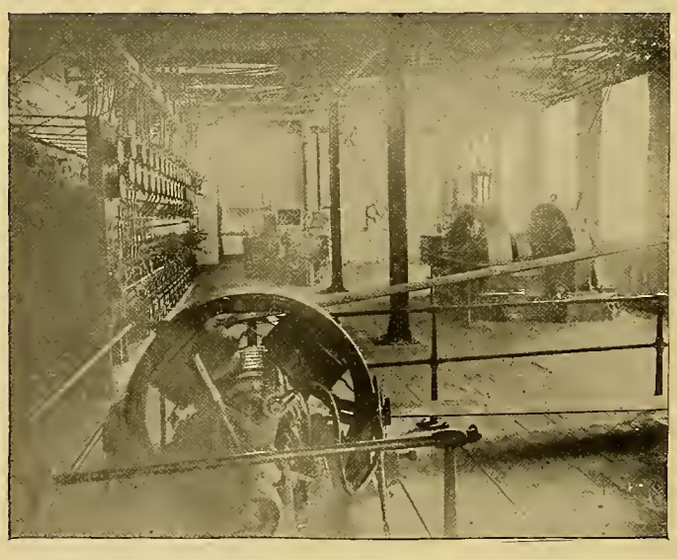

Fig. 1. Power Station, Farrel Foundry and Machine Company, Ansonia, Conn.

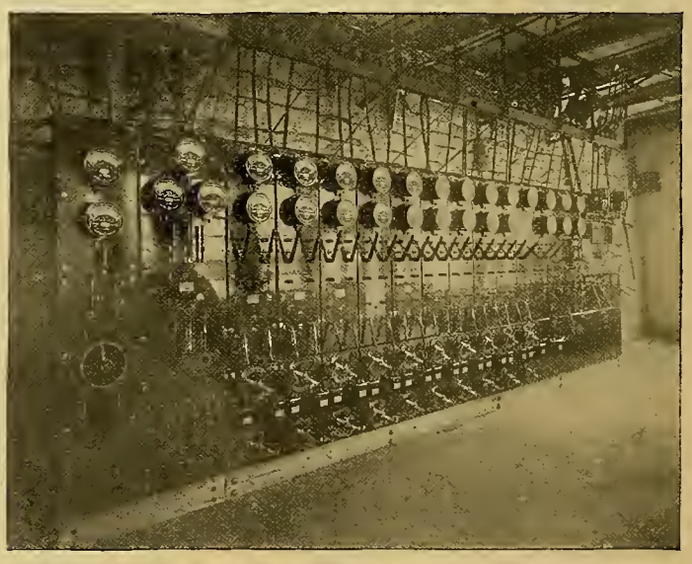

Fig. 2. Switchboard in Power Station.

UTILIZATION OF WATER POWER ELECTRICALLY TRANSMITTED TO ANSONIA, CONN.

Steam Railroad Engineer Discusses Electric Traction.

The *Chicago Record* prints the following experience of opinion in an interview with "the chief engineer of a strong western road," upon the possibility of substituting electric motors for steam locomotives upon the big railroads of the country:

Undoubtedly the time is coming when electricity will be used to operate the railroads of this country. Little by little the electric motor is winning its way. It began by knocking out horses on street car lines; then it entered the fight for suburban business with steam roads, and in many cities and on many lines has won a decisive victory. But it will be many years yet before the electric motor will supersede the steam locomotive on main lines. The third-rail system is all right for elevated railroads, or for a railroad whose right of way is so completely fenced in that passengers cannot cross the tracks and trespassers cannot walk over the roadbed. But the third rail would be a constant source of peril on railroads with an open road-bed, and, if used, switchmen and trackmen would have to wear rubber boots, and then would not dare run over the tracks at night. Electricians are optimistic individuals, but as yet they cannot give us a practical method of bringing the current to motors large enough and heavy enough to pull 30-car freight trains or 10-coach passenger trains which make an average speed of 50 miles an hour. The overhead trolley is not a practical device for trains as heavy and fast as the ordinary trains on railroads to-day. The third-rail system will not do except for elevated roads, and the storage-battery system is far from being a proved success even for street cars.

But one of the most serious obstacles in the way of electric traction for railroads is found in the fluctuations of business done on railroads. This applies to the freight business. In installing electricity on a road, the road would have to be divided into comparatively short divisions, each with its own power plant. Now, the experience of every railroad is that the freight business is subject to violent fluctuations on its several divisions.

For instance, on one division the movement of freight will be so heavy that engines, crews and cars must be drawn from other divisions. At the same time, on another division, the freight business may be so light that but few engines will be in service. Now, in installing the road for electricity, the power plant, boilers, engines, generators, feed wires, and so on, must be of a capacity to care for the maximum business on that division, and this maximum power will only be used for about eight per cent. of the year.

With steam locomotives there is an elasticity in the service which makes it easy for us to meet the fluctua-

tions, but this could not be done with electric service; at least, not as it is at present. That is a feature of the question which few electricians have ventured to tackle, but until that particular question is solved electric motors on railroads will be confined to suburban business.

Protection of Ocean Cables.[1]

The claim of the submarine cables to international recognition and protection is based partly upon the fact that they traverse the high seas, and partly because their termini rest within the territorial jurisdiction of different states. These circumstances constitute their conspicuous feature, and the practice of regarding them in their international aspect preceded proclamation of principles in respect of their treatment by the nations.

It soon became evident, however, that the proper protection of such cables could only be assured by enlisting the co-operation of the great powers. With this end in view, in 1869, the secretary of state, under direction of President Grant, addressed a diplomatic circular to the maritime powers, in which he expressed the conviction of the president that "the present moment was favorable for the negotiation of joint convention of the maritime powers of the world for the protection of submarine cables."

The United States, he continued, had a peculiar interest in fostering the preservation of these indispensable avenues of intelligence and in protecting them against wanton injury. The cable between Cuba and the United States had recently been cut. Experience had shown that the assumption by one nation to control the connections with the shores of another would lead to complications that would, unless arranged, result in preventing all direct communication between the two countries.

General Grant deemed that such a result could best be prevented in future by providing that hereafter no exclusive concession should be made without the joint action of the two governments whose shores are to be connected. A draft for a convention was enclosed in the circular, consisting of several well drawn articles, whose purpose was to secure the safeguard of submarine cables from wanton injury or destruction in time of war, as well as during periods of peace. It proposed to prevent wanton injury or destruction by a joint declaration that such acts shall be deemed to be acts of piracy and punished as such. It contained provisions against scrutiny of messages by government officials.

The powers were invited to authorize their representatives at Washington to enter into a conference for the purposes indicated. The Franco-Prussian war intervened, and its prevalence, and possibly other reasons, prevented the conference at Washington. Conferences, however, were held subsequently at Rome, Brussels, St. Petersburg and Paris, where the propositions announced by the United States were zealously advocated and opposed.

At an international convention for the protection of submarine cables, held in Paris in 1884, a convention was signed by representatives of 26 powers for the protection of submarine cables in the high seas, but it was limited in its operation in general to time of peace, as appears from the terms of article 15, which was in these words:

"It is well understood that the stipulations of the present convention do not affect the liberty of action of belligerents."

In the year 1879 the subject of the protection of the submarine cables was much discussed by the members present of the Institute of International Law, and the following resolutions were adopted by the Institute:

"It would be very advantageous for the different states to agree upon a declaration that the destruction or injury of submarine cables in the high seas is an offense against the laws of nations, and to determine in a precise manner the criminal character of the acts and the punishments applicable; on this last point such a degree of uniformity would be reached as is compatible with the diversity of criminal legislation.

"The right to seize offending individuals, or those presumed to be such, may be given to the public vessels of all nations, under conditions regulated by treaties, but the right to adjudicate should be reserved to the national tribunals of the captured vessels.

"The submarine telegraphic cable which connects two neutral territories is inviolable.

"It is to be desired when telegraphic communication must cease as the result of a state of war, that only measures strictly necessary to prevent the use of the cable should be employed, and that an end should be put to these measures, or that the consequences should be repaired as soon as the cessation of hostilities will permit."

The committee declined to adopt the proposition of the United States that the wanton destruction of submarine cables should be assimilated to piracy, on the ground that the punishment would be too severe and out of proportion to the gravity of the offense. But why should not the state, corporation or individual that would wantonly destroy this now necessary avenue of communication between the states and communities of the world be treated as *hostis humani generis*?

The end to be accomplished is the safeguard of these instruments of communication and commerce at all times. Terms are more or less inaccurate when subject to a mere verbal criticism, and the methods necessary to attain the end involve considerations not necessary to enter upon here. It matters little whether the process which secures protection is described as "internationalization" or as "neutralization," provided the end in view is attained.

It is patent that a public sentiment is aroused among civilized peoples which insists that war and its attendant horrors shall be avoided when possible, and that all the agencies which make in favor of the perpetuation of peace among nations shall be employed and encouraged. The internationalization of submarine cables will draw the nations nearer together and bring home to them what interest as well as justice demands in this relation. This may be accomplished along the lines of the draft contained in the diplomatic circular addressed by the United States in 1869 to the maritime powers. The selfish commercial interests of states, not to mention higher motives, would seem to dictate such a joint declaration.

It is noteworthy that the great submarine cables are owned and operated by private corporations or companies composed of individuals who are citizens or subjects of many different nationalities, and that comparatively

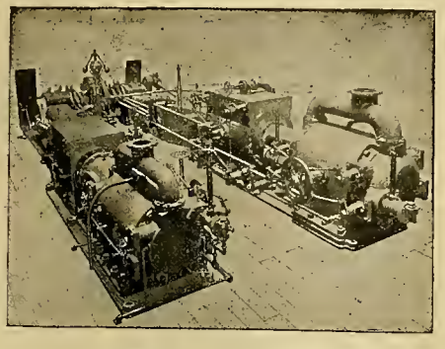

FIG. 2. PHILADELPHIA TYPES OF CORLISS ENGINES.

few long cables are owned or operated by states. There are 310 submarine cables owned by private corporations or companies, having a length of 139,754 nautical miles, and the length of cables owned by states is 18,132 miles. There are but two great plants, one in England and one in France, for the fabrication of cables and cable supplies, and specially constructed vessels are required to lay and repair cables.

Twelve cables traverse the North Atlantic; 11 are owned and operated by American or English companies, and one by a French corporation. All of these have their termini in the territory of the United States or of Great Britain except two, which have termini in France. Three cables, one American and two foreign, traverse the South Atlantic.

The policy of the United States in reference to the landing of foreign cables within the territory, as indicated by executive action at least, is based upon considerations that are opposed to the amalgamation or consolidation of competing companies, and demands from foreign governments reciprocal privileges for American citizens and companies. It has been assumed that the control of power to regulate the landing and operation of such cables is in the federal government, and that the executive will exercise the power in the absence of legislation by Congress. The subject, however, is in a somewhat hazy and indeterminate state at present, and various bills are pending before Congress to regulate the establishment of submarine telegraphic cable lines or systems in the United States.

The best thought of statesmanship should be invoked to formulate such legislation as may be appropriate and correspondent to the large subject. Nice questions as to the conflict of jurisdiction between the states and federal government may arise, which may require adjudication by the courts, but meanwhile, for purposes of defense, those avenues of international communication and foreign commerce may be regarded as subject to the power and jurisdiction of the federal government.

This subject was called to the attention of Congress by the late attorney-general, who submitted his views on one or two points, and suggested for the consideration of Congress whether it would not be wise to give authority to some executive officer to grant or withhold consent to the entry of foreign cable enterprises into this country on such terms and conditions as may be fixed by law.

"The existence," says the attorney-general, "of any executive authority over the subject is at present involved in doubt, and the United States Circuit Court, in which a recent suit was brought, appeared to be somewhat doubtful as to judicial authority in the matter."

Philadelphia Types of Corliss Engines.

By the accompanying illustrations are shown two types of heavy-duty engines, with Corliss valve gear, made by the Philadelphia Engineering Works. Fig. 1 shows a balanced slide-valve reversing rolling mill engine with cylinders 24 inches in diameter and having a stroke of 42 inches. The main shaft is 16 inches in diameter, and the weight without fly-wheel or gearing is 110,000 pounds. The frame is exceptionally heavy and massive. The main throttle valve and quick-closing valves at each cylinder are all operated from the platform shown. The engine is completely under control from that point. The main bearings are ample and are fitted with loose bottom boxes and quarter boxes, the cap, of extra strength, securing the frame as it lips over both the inside and outside. This engine gives a complete contact with the foundation from the end of the cylinder to and beyond the center of the main shaft.

Fig. 2 represents a compound air compressor driven by a cross-compound condensing steam engine. The two air cylinders are operated by elongation of the piston rods, the low-pressure air cylinder being tandem to the low-pressure steam cylinder and the high-pressure air cylinder tandem to the high-pressure steam cylinder. There is no merit in this special disposition of the cylinders except harmony of design, for the power delivered by the high-pressure cylinder is equal to that delivered by the low-pressure cylinder, and the power required by the low-pressure air cylinder is the same as that required by the high-pressure, or compression, air cylinder. The steam cylinders are 22 and 40 inches in diameter; stroke, 48 inches. The high-pressure cylinder is steam jacketed. The air cylinders are 38 and 23 inches in diameter, both carefully water-cooled by water jacketing, without spray. The cylinders on each side are bolted to common bed-plates. This compressor is guaranteed to show 88 per cent. of theoretical isothermal efficiency, and the friction at rated duty will not exceed 10 per cent. of the indicated horse power of the steam end. Thus the power represented by the compressed air within the receiver after it is cooled to its initial temperature will be 90 per cent. of 88 per cent., or 79.2 of the indicated horse power of the steam end. This engine is guaranteed to indicate a horse power with 14 pounds of steam delivered to the throttle valve at 125 pounds gauge pressure per hour, so that the power represented by the compressed air will require but 17.7 pounds of steam per horse power per hour.

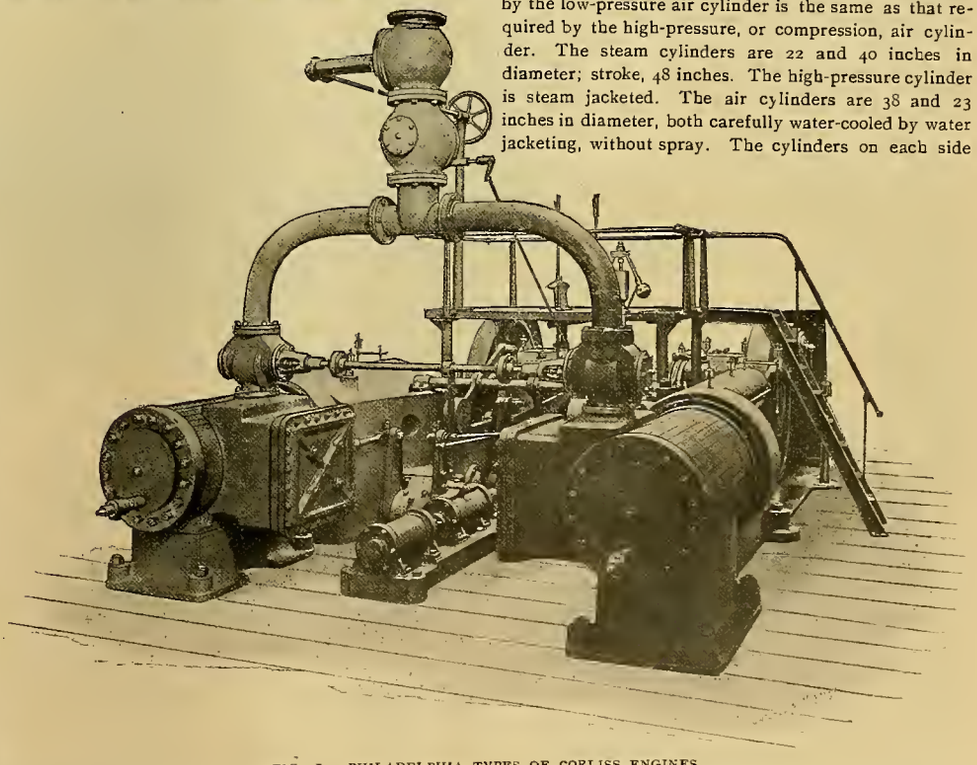

FIG. 1. PHILADELPHIA TYPES OF CORLISS ENGINES.

1. Abstract of communication of Alexander Porter Morse of Washington, D. C., in *New York Herald*, July 19, 1897.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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CIRCULATION, 20,000.

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WITH the Niagara Falls convention number of the WESTERN ELECTRICIAN, dated June 12, 1897, this journal made a new record for itself both in circulation and advertising. Of this 100-page number 20,000 copies were printed and circulated and the amount of full paid advertising matter carried was 8,643 square inches.

The remarkable success of this journal, especially in view of the hard times that have prevailed throughout the country, is all the more striking because of the fact that it is only 10 years since the first number was issued. Its advancement has been rapid and in keeping with the progress of the great industry it represents and the splendid field which it occupies. It is a noteworthy fact, especially in view of existing conditions, that during the period of depression this journal has made steady gains in advertising. Beginning with the convention number of March 3, 1894, the record shows constant gains each year until in the present case the number of square inches of full paid advertising matter is more than double that of the 1894 number. The figures showing this unprecedented gain are given in the accompanying table:

Issue.	Number of Advertising Pages.	Whole Number of Pages.	Square Inches of Paid Advertising Matter.
March 3, 1894....	40	56	4,145
February 23, 1895.	52	68	5,593
May 9, 1896.....	72	88	7,576
June 12, 1897.....	80	100	8,643

This constantly increasing patronage speaks eloquently of the influence and merit of this journal and of the confidence and respect which it commands throughout the country. It is pleasing recognition of the efforts that have been made in the interest of the entire fraternity.

MUNICIPALITIES have the right to prescribe a speed limit for trolley cars. The question has been contested in Brooklyn, where a hundred or more cases of violation of the city ordinance regulating the speed of trolley cars have been brought against the local companies. In a test case recently decided, the Appellate Division of the Supreme Court in Brooklyn handed down a decision upholding the validity of the trolley car speed ordinance adopted by the aldermen, and fixing eight miles an hour as the limit. The Nassau company had been fined $25 by a police justice for a single violation of the ordinance, but the judgment was reversed in the County Court. The appellate division now sustains the ruling of the police justice. Justice Cullen, who prepared the decision, says that it is as much the duty of the Legislature to protect the traveller from unnecessary danger to his person while he is on the highway as his health from infection while he is in his home, and that the power to perform either obligation may be delegated to others. No doubt this decision will be taken as a precedent in other states.

PLANS for illuminating the falls of Niagara are described on another page of this issue, and the methods employed as well as the apparatus used are illustrated. The project will doubtless attract considerable attention, especially in view of the fact that acetylene, and not electricity, is employed. The scheme, it should be explained, is in the nature of an advertisement for the acetylene interests at Niagara Falls, which are closely allied to the electrical interests. An excellent opportunity will be afforded this new illuminant to show its powers of penetration, for which great claims have been made. It would seem that thus far the experience of the promoters has been somewhat disappointing. Mr. Dunlap, in his interesting article on these experiments, incidentally alludes to this failure. He says: "The expanse of the water between the islands and mainland is so great that the lights do not appear to penetrate to any great distance, but this is said to be due to the lack of proper apparatus rather than to the gas." It is to be hoped that such an excellent opportunity to test the relative merits of acetylene and electricity for the operation of searchlights will not be allowed to pass without a comprehensive investigation of the subject being made.

OVERCROWDED cars are a nuisance at all times of the year and particularly in warm weather. Just now the newspapers of New York are protesting vigorously against the policy of the street railroad companies of that city, and in other large towns there are similar complaints. In Chicago, while it must be admitted that the street railway service generally is good, it is only too true that there is reason for protests against the failure of the companies to provide a sufficient number of cars during the rush hours. On some lines passengers are crowded and huddled together like sheep, greatly to their discomfort and annoyance. Of course the fault lies with the management in not providing for the comfort of passengers. An idea of the extent to which this overcrowding is carried in Chicago was illustrated last Sunday, when a north side trolley car that was intended to accommodate only 40 passengers started out of the barns with 96 on board. When the conductor had rung up that number of fares his attention was called to the fact and he remarked that he had carried 120 passengers on an earlier trip. On Thursday evening a north bound Larrabee street trolley car left Washinnton street with 106 passengers on board, although there was provision for comfortably seating only 40. Of course common decency is outraged by such a policy and patrons are obliged to submit to many inconveniences. The street railway companies ought to be anxious at this time to win the favor of the public. They will certainly need it when consideration of their claims for extension of the life of their franchises is in order.

CONSIDERATION of an agreement to protect submarine telegraph cables in time of war is being seriously urged by naval authorities and by others directly interested in the subject. A plan of this kind has been favored by this country ever since the first Atlantic cable was laid. It will be remembered that President Buchanan's message to Queen Victoria on the occasion of the opening of the line contained the following allusion to this subject: "Will not all nations of Christendom spontaneously unite in the declaration that it [the cable] shall be forever neutral and that its communications shall be held sacred in passing to their places of destination even in the midst of hostilities?" This policy has been strictly adhered to by the government of the United States and has been urged upon the other great nations of the world, but has never been formally accepted by them, although on several occasions the subject has been considered and provision of some kind for the protection of ocean cables recommended. An interesting communication from Alexander Porter Morse on this subject in the *New York Herald* is reprinted on another page of this issue. Mr. Morse carefully reviews the efforts which have been made by our government to bring about this result and the reasons which have prompted its action. Among those who were particularly zealous in this cause was President Grant, who was fully alive to the importance of protecting ocean cables in time of war as well as peace. He took active steps to accomplish that object, but without success. In 1884 an international agreement was signed in Paris by the representatives of 26 powers, but unfortunately its operation was limited to time of peace. A systematic effort to bring about an international agreement extending to times of war as well as peace might well be made by our government at this time. It would be consistent with its policy and would reflect great credit upon any administration that might bring it to pass.

POLITICS and patriotism are sadly mixed in the land of the jubilee, and some of the colonial representatives, who have been pledging themselves and their constituencies to the imperial idea, are wondering whether they will be able to keep their promises when the developments in the Pacific cable scheme become known. It is now generally understood that the Eastern Telegraph company is the controlling spirit in the enterprise, and, in the event of the cable being laid, it is admitted that it will become a part of the great telegraph monopoly. Official confirmation of this news is bound to produce a sensation, and it will unquestionably call forth a universal protest from all who are interested in the enterprise. The government will find it difficult to satisfy the colonies that joined England in the necessary guarantees. Canada and Australia and New Zealand will have to be pacified. Already annoying questions are being asked, indicating the suspicion in the public mind that the people have been duped by the government officials or else that the latter have shown themselves unequal to the task of dealing with the Eastern Telegraph company.

How and when did the Eastern company gain control of the enterprise? It will be remembered that when the scheme of laying a cable between Vancouver and Australia was first mooted the Eastern Telegraph company declared its opposition, as the proposed cable threatened one of its most profitable monopolies and promised to release the British colonists from the thralldom under which they had long groaned. This opposition only served to make the scheme popular, and when Mr. Chamberlain became secretary of the colonies he displayed considerable interest in this cable scheme. The Eastern company brought vast political influence to bear upon the government, but it was commonly believed that it was unable to make an impression. During all this time there were many persons who declared that the opposition of the Eastern company was not genuine, that it was simulated merely for the purpose of making the scheme popular, and that when the plans were decided upon it would be found that the old monopoly had gained entire control of the project. While these assertions attracted little attention at the time, it is certain that in the light of subsequent events they give the colonists grounds for demanding an investigation. It is not to be expected that these developments will tend to arouse or increase enthusiasm for the Pacific cable in Canada, Australia and New Zealand.

VANDEPOELE DECISION.

New York Circuit Court of Appeals Declares the Patent Invalid.

A decision of great importance to the electric railway interests of the entire country was handed down in New York on July 22d by the United States Circuit Court of Appeals. It held the Vandepoele under-running trolley patent to be invalid on the ground that a previous patent on the same construction had been issued to Vandepoele. Judge Wallace wrote the opinion, in which all the judges concurred.

The patent in suit is known as the broad patent for the under-running trolley. It is numbered 495,443 and it was issued to Charles J. Vandepoele on April 11, 1893. It is entitled "Traveling Contact for Electric Railways," and was assigned by the inventor to the Thomson-Houston Electric company and is now, of course, the property of the General Electric company. It has been considered one of the latter company's most valuable assets, as it was believed to cover every method by which a practicable connection could be made between a car and an overhead trolley wire, in which the trolley wheel presses up against the wire. No other scheme of connection between car wiring and trolley wire has been found so practicable, although several have been tried. With this patent in its possession, therefore, it looked as though the General Electric company would have a monopoly of the business of supplying the trolley connections to all of the electric cars of the country of the ordinary type. In addition, it was charged that the company's policy was to sell trolleys at a reasonable price only to those electric railway companies that used General Electric apparatus. Thus it would have a tremendous leverage on the whole electric railway business of the country. Several suits were begun to secure injunctions for infringements of this patent. One of these was against the Hoosick Railway company, although the Walker company supplied the equipment complained of and was the real defendant. In this case the Vandepoele patent was upheld; but the present decision, which was reached on appeal, reverses that of the lower court, and, as has been said, pronounces the patent invalid. The case can go no higher except in the rather unlikely event that some other Circuit Court of Appeals should uphold the patent. This is not apt to happen, as courts of last resort of equal powers usually respect the doctrine of comity and follow the decision first reached on the merits of the case. However, should one Circuit Court of Appeals hold to one opinion and another to a contrary view, the issue could be brought to the attention of the Supreme Court of the United States, which, if it desired, could issue a writ of *certiorari* and bring the matter before it for final adjudication.

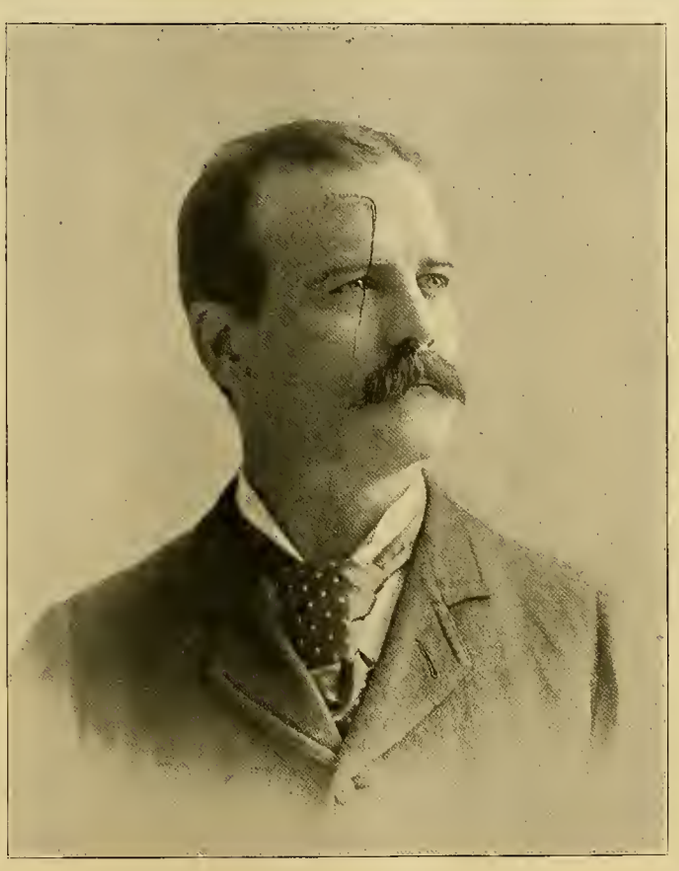
There is now pending a suit on this patent brought by the Thomson-Houston Electric company against the Ohio Brass company. This is in the Circuit Court of Appeals that sits in Cincinnati, and was the first of these infringement suits to reach the appellate court. In granting the preliminary injunction in this case the court expressed doubt as to the validity of the patent, but declined to go into the merits on an application for a preliminary injunction.

In holding the broad Vandepoele patent invalid by reason of the fact that the same invention was disclosed in an earlier patent to Vandepoele, the court undoubtedly refers to patent No. 424,695, granted to Mr. Vandepoele on April 1, 1890, for a "Suspended Switch and Traveling Contact for Electric Railways." In the two patents the drawings seem to be identical, but the claims in the later one are much broader. The practice of securing a broader subsequent patent on the construction described in a previous patent has heretofore been held by the Supreme Court to invalidate the later patent.

There seems little doubt that this decision will give to the whole country the benefit of competition in an important part of the equipment of electric railways.

Thomas R. Mercein, Secretary and Treasurer Northwestern Electrical Association.

Probably no man engaged in the electrical business in the West, and particularly in the Northwest, is better known in the electrical fraternity than Thomas R. Mercein, the subject of this sketch, whose portrait appears on this page. It is unquestionably true that among central station men of that section of the country Mr. Mercein has a wider personal acquaintance than any other man in the business. This condition is due largely to the active interest he has displayed at all times in the Northwestern Electrical association and to his own personal efforts in promoting the welfare of the organization. His position as secretary and treasurer of the association has brought him into contact with the men actively engaged in central station work throughout the Northwest.



THOMAS R. MERCEIN.

In this organization, as in others of a similar character, experience has shown that while the great body of members may be enthusiastic in support of its policy and aims, the work of organizing forces and directing affairs must be assumed by some individual member or officer in order to secure results at all compensating for the exertion expended. For several years it has fallen to the lot of Mr. Mercein to act in this capacity for the Northwestern association, and the best evidence of his competency and faithfulness is presented in the work accomplished during his tenure of office. He has proved a very efficient and popular officer and is highly esteemed by his fellow members, who took occasion a year ago to mark their appreciation of his services by presenting him a diamond badge.

Mr. Mercein was born at Vicksburg, Mississippi, but the principal part of his education was received in the North. He completed a course at the Brooklyn Polytechnic Institute and practiced as a civil engineer for several years in the East. In 1877 he was attracted to Milwaukee and there engaged in business as a real estate and investment broker. He was secretary and general manager of the Milwaukee Exposition association for two years, and not a little of the success of that enterprise is due directly to his personal efforts.

When electric lighting began to attract attention in Milwaukee, Mr. Mercein took an early opportunity to investigate the subject, and, securing an opening in this field, he entered it with much enthusiasm. He became secretary and general manager of the Badger Illuminating company of Milwaukee and had the distinction of installing the first arc lights in that city. He remained with the Badger company four years, during which period it developed into an enterprise of considerable importance.

Mr. Mercein was interested in many other ventures, including the Milwaukee, Lake Shore & Western Railway company and the Wisconsin Central Railway company, in both of which he held official positions. Later he became interested in the Milwaukee Auxiliary Fire Alarm company, and at the present time he is devoting most of his attention to that system. He is secretary and general manager of the company.

Mr. Mercein is popular with his townsmen and with his fellow workers throughout the state, as well as with the fraternity generally in the Northwest. He is president of the Wisconsin Electric club, which has done excellent work in Milwaukee, and he has contributed materially to the success of the organization.

Mr. Mercein represented the Northwestern association at the New York convention of the National Electric Light association in May, 1896, and again at the Niagara Falls convention last month. He made many friends for the young organization at both gatherings. Personally, Mr. Mercein is a very agreeable and entertaining companion, and he has gained some reputation as an after-dinner speaker. He has certainly contributed valuable services to the Northwestern Electrical association, and his associates are always ready to certify their appreciation of his work in behalf of the organization.

Remarkable Power Attributed to X-rays.

[From the New York *Sun*.]

As bearing on the general criticism of having laymen instead of doctors act as superintendents of the city hospitals, the following story is told about the superintendent of a down-town hospital by a Philadelphia man whose business brings him into contact with the directors of hospitals and other public institutions. About a year ago the Philadelphian had occasion to call on this superintendent. At that time the entire civilized world was ringing with the wonder of the newly discovered X-ray. The newspapers were full of it; doctors all over the country were experimenting, and it was easily the foremost scientific topic of the day. Having concluded the business on which he came to the hospital, the Philadelphian said to the superintendent:

"Have you been doing anything here with the X-ray?"

"With what?" asked the official.

"The X-ray. Prof. Röntgen's discovery; this new, penetrating light."

"Never heard of it," replied the superintendent; "and anyway I don't take any interest in these fancy lighting schemes. We've got the incandescent light in this hospital and it's good enough for us."

"But you don't understand," said the Philadelphian. "This is the X-ray for surgical operations and that sort of things. It enables——"

"Oh, I know, I know," interrupted the other. "Agents are constantly in here trying to sell me improved burners and things for the operating rooms. But I don't pay any attention to those things."

"Nevertheless," replied the Philadelphian, gravely, "I think you would be interested in this when you found out about it. It's a curiously penetrating ray, will penetrate a very thick, solid substance, like your skull, for instance. You really ought to have one in your office."

And later, when the superintendent found out about the X-ray, he remembered that remark and wondered if his visitor hadn't been guying him.

It is alleged that the fluoroscope has been pressed into service by the French customs officers to detect smuggled articles concealed beneath the clothing of travelers. With the aid of the X-ray, jewelry, watches, and other articles of the sort concealed about the person are shown as readily as the shape of the bones and foreign substances present in the body. It is said that during the progress of the Paris experiments a bottle of wine was found on a woman.

THE CONVENTION

Of the Northwestern Electrical Association at La Crosse, Wis., July 21 and 22, 1897.

Another successful meeting must be added to the list of gatherings of the Northwestern Electrical association that have contributed so much to the advancement of the interests of the fraternity in the great Northwest. The La Crosse meeting has been no exception to the rule, and this year's midsummer gathering will be remembered as one of the most enjoyable in the history of the association.

The delegates assembled in the city hall at La Crosse, Wis., July 21st, at 10:30 A. M. In the absence of President Higgins, Vice-president Cole acted as chairman of the opening session. There was a large attendance, including an excellent representation of central station managers and supply men. There were also many prominent citizens of La Crosse present to welcome the visitors and show their interest in the object of the meeting.

F. A. Copeland of La Crosse, who had done so much to make the convention successful, presented each member of the association with a unique souvenir of the occasion in the shape of a celluloid and metal badge, bearing the inscription, "Summer Meeting, Northwestern Electrical association, La Crosse, Wis., July 21, 1897," the reverse containing a view of the city, showing the power house, Mississippi river and bridge also. Prolonged applause greeted the announcement of the distribution of these souvenirs, which were proudly worn by all members of the association.

The proceedings were formally opened by Vice-president Cole, who delivered a short address. This was followed by roll-call and presentation of the report of the committee on programme, which was accepted.

Considerable enthusiasm was displayed on the announcement that there were 25 applications for membership. These were taken up in order and passed upon. One resignation, that of A. C. Bunce, was presented, and was received with regret, as Mr. Bunce had been a very faithful and valued member. Recess was then taken.

The delegates reassembled after lunch and the practical work of the meeting was begun. First of all a paper on the subject of "Utilization of Exhaust Steam" was read by George L. Thayer of Belle Plaine, Iowa, and was thoroughly discussed. Prof. G. D. Shepardson of the University of Minnesota read a paper on the subject of "220 Volt Lamps," which also provoked considerable discussion.

The association then adjourned to the racing park and witnessed some remarkable athletic performances by some of its members.

In the evening a trolley party was enjoyed, and the most attractive parts of the city and its suburbs were visited by the members.

The first day's proceedings were closed with a complimentary concert tendered the association at Germania Hall.

The second day's session proved as interesting as the opening meeting. Several additional applications for membership were accepted. The convention then went into executive session, and the committee on legislation presented its report, which was accepted.

Mr. Dee offered a resolution providing that the secretary be instructed to confer with the secretary of the National Electric Light association as to what action the two associations would take with regard to making a report on municipal ownership to the bureau of statistics at Washington. The motion was unanimously adopted.

A formal vote of thanks was extended F. A. Copeland for his efforts in providing entertainment and perfecting arrangements for the meeting.

Secretary Mercein read a paper upon "The Constant Potential Arc," prepared by O. M. Rau and F. A. Vaughn.

"The Meters of To-day" was the subject of a paper by R. F. Schuchardt, which attracted considerable attention and provoked quite a spirited discussion. This closed the programme as prepared by the committee.

The secretary was instructed to publish 500 copies of the report of the meeting for distribution among the members.

The chairman appointed as committee of entertainment for the next meeting H. L. Doherty, W. L. Church and L. B. Caswell, Jr. He also appointed as special committee for municipal subjects W. W. Bean, J. R. Dee and A. A. Cross.

It was unanimously decided that the association express its thanks to the La Crosse Street Railway company for the use of its lines of road, to the city officials for the use of the city hall, to the Germania society for the use of its hall and to the representatives of the local press for courtesies extended.

The report of the secretary and treasurer, which was approved, showed the financial condition of the organization, a detailed statement of receipts and expenditures being presented. Concerning the work of the association during the year, the report says:

In accordance with a resolution of last convention, and after due notice, I dropped 22 names from membership for non-payment of dues; five members resigned, and one died. The shrinking of apparent assets from these causes is $270.

On February 9th I mailed postal notices to all central station plants that had not filled out and returned the question list sent them on October 10, 1896, and after waiting 30 days, as instructed, for their replies, I compiled, tabulated and indexed the information on hand and applied for estimates thereon. The lowest bid for printing obtainable was $102 for 300 complete pamphlets with separate key and index. I notified each member and contributing plant that the necessary expense of the books would prevent the association from furnishing them free, as contemplated, and that they would be mailed on application at cost, 50 cents each. For some time thereafter I was burdened with 50 cent remittances in postage stamps of all denominations and conditions. Some had been previously licked, and others had been carefully and firmly attached to the letter accompanying them. However, I negotiated the most of them successfully, and on March 30th mailed the complete, copyrighted pamphlet with its key and index to each subscriber. With all due modesty, I consider the pamphlet one of the most valuable compilations issued in this territory by any electrical or other association. It is worth 10 times its price to every central station man in the Northwest, and I would not compile another for 20 times that sum. Eighty-four copies were applied for, and the remaining 216 copies are on hand at this convention, and I trust they will all be taken before adjournment. The pamphlet contains 8,588 questions and answers, and covers central station reports from nine northwestern states.

Thirty new members were elected in January. That convention adjourned on January 23d, and on March 10th the full printed report thereof was mailed to each member and to central station plants in the Northwest. With each report was sent a copy of Prof. Jackson's valuable circular of January 25th, 500 copies of which he kindly sent me at my request. The result was to increase that gentleman's mail by some hundreds of inquiring letters, rather to his dismay, as he evidently had not counted upon the inevitable effect of this association's advertisements.

On March 19th, at the request of the protective committee, I notified all Wisconsin members of the necessity for concerted action to defeat Wisconsin Assembly Bill No. 406, and on April 6th, with Chairman Norcross, I visited Madison concerning that and other legislation.

On June 7th, by appointment of the president, approved by a majority of the directors, I attended the National Electric Light convention at Niagara Falls, and was enabled to practically cover the cost of the trip by securing 11 new members while there.

On June 25th, first, and on July 12th, second, notices of this convention were mailed to all members, and first notices were also mailed to all central station plants in Iowa and Minnesota.

At the request of the special committee I have had correspondence with the Fort Wayne Electric corporation concerning an alleged promotion of municipal ownership in our territory.

I had proposed to make this convention notable by arranging therefor a full and free discussion of the important question of municipal ownership, and inviting prominent advocates and opponents of such ownership to meet on our arena without fear or favor, assuring both of equal courtesy and hearing, but on consultation with the president and directors on the matter it was decided not to carry out the plan. I want this association to lead when it can and follow only when it must, and I think that the association that does, at the proper time, permit and encourage such a discussion, will not only win a valuable prestige and reputation, but through the results of such a discussion do much to stifle the rank growth of the municipal ownership idea. I have had to visit Chicago frequently in the interests of the association and have been able to secure a largely increased list of advertisers. In this connection, and solely to forestall possible unjust criticism of my successor in office, I beg to remind you that secretarial duties do not usually include the soliciting of advertisements or the sale of convention matter; that the officer should not be expected nor be considered remiss if he fail to provide you with an annual income from those sources of nearly $700, as the present incumbent has been fortunately able to do and has gladly done, but in so doing has established a precedent that may some day cause an unreasonable disappointment. I regret to announce that since the first notices of the convention were mailed it has been found impossible for C. F. Scott of Pittsburg to deliver his promised paper at this time but it is only a pleasure deferred to next January's meeting.

Rush & Mason of Forest Mills, Minn., contemplate furnishing Zumbrota, Minn., with electric lighting.

Members and Visitors.

Following is a list of the delegates and others in attendance at the convention:

Abadie, E. H. ..... St. Louis
Albrecht, A. L. ..... La Crosse
Andrae, Herman ..... Milwaukee
Bacon, C. W. ..... Madison
Bean, W. W. ..... St. Joseph
Bell, G. C. ..... La Crosse
Benton, W. F. ..... La Crosse
Boyer, F. N. ..... Chicago
Burns, P. C. ..... Chicago
Burton, Charles G. ..... Chicago
Bunch, L. W. ..... Madison
Cole, G. S. ..... Beloit, Wis.
Cooke, J. W. ..... Chicago
Copeland, Col. F. C. ..... La Crosse
Cross, A. A. ..... West Superior, Wis.
Cutter, George ..... Chicago
De Bell, E. L. ..... Sheboygan
Dee, J. R. ..... Houghton, Mich.
DeLand, Fred ..... Chicago
Dodge, H. C. ..... Chicago
Doherty, H. L. ..... Madison
Esperson, H. L. ..... La Crosse
Espersen, A. F. ..... La Crosse
Faust, Caspar ..... Rhinelander
Ferris, Tom ..... Milwaukee
Finn, George H. ..... St. Paul
Ford, F. H. ..... Madison
Foster, G. B. ..... Chicago
Garrison, A. C. ..... St. Louis
Gill, H. J. ..... St. Paul
Greenwood, C. H. ..... La Crosse
Hackney, H. C. ..... Madison
Hill, Joseph M. ..... Chicago
Howard, S. B. ..... Minneapolis
Hurlbut, J. D. ..... Sparta
Jones, George H. ..... Fond du Lac
Kammeyer, C. E. ..... Chicago
Kellogg, F. ..... Spencer, Iowa
Killman, F. I. ..... La Crosse
Knuteson, I. E. ..... La Crosse
Korst, P. H. ..... Racine
Leuermire, S. B. ..... Winona
Lohmiller, William ..... La Crosse
Loper, A. N. ..... New Haven, Conn.
Low, W. W. ..... Chicago
Luther, F. P. ..... Chicago
Marks, J. H. C. ..... Freeport, Ill.
McDonald, W. D. ..... La Crosse
McGill, T. Julian ..... Chicago
McIntyre, J. D. ..... Syracuse
McMasters, F. ..... Chicago
Mercein, Thomas R. ..... Milwaukee
Miller, W. L. ..... Winona, Minn.
Morgan, C. M. ..... Postin, Minn.
Newton, George M. ..... Sparta, Wis.
Norcross, Pliny ..... Janesville
Paige, C. C. ..... Oshkosh
Pearce, H. F. ..... Negaunee
Pease, C. H. ..... Richland Center, Wis.
Perry, F. L. ..... Chicago
Richardson, L. D. ..... La Crosse
Ross, C. A. ..... Chicago
Schuchardt, R. F. ..... Milwaukee
Schumacher, Charles C. ..... Chicago
Schuette, John ..... Manitowoc
Sherwood, J. J. ..... La Crosse
Smith, W. R. C. ..... Chicago
Stevenson, M. S. ..... Chicago
Stiles, George S. ..... La Crosse
Sullivan, W. P. ..... Chicago
Swain, R. A. ..... Chicago
Thayer, George S. ..... Belle Plaine, Iowa
Tuttle, H. A. ..... Minneapolis
Upham, W. P. ..... Chicago
Valier, Peter ..... La Crosse
Whyte, George S. ..... Chicago
Withee, N. H. ..... La Crosse
Withee, W. W. ..... La Crosse
Wolff, James ..... Chicago
Zanel, A. G. ..... Chicago

Social Features.

At the termination of the afternoon session on Wednesday all thought of business was thrown aside and the entire party adjourned for the bicycle races on the local race track. This feature of the amusement programme proved a most entertaining one. Arriving at the track officers were selected as follows: Judges, C. C. Paige of Oshkosh, Fred DeLand of Chicago, and Col. Copeland; starter F. L. Perry, Chicago; timers, T. R. Mercein and Tom Ferris. The rule was that the winner of each heat was to receive his prize and drop out. A heat consisted of one trip around the half-mile track. In the first race there were quite a number of contestants. The list included T. J. McGill, James Wolff, F. McMasters, J. D. McIntyre, J. V. S. Church, G. B. Foster and two local men, Otto Langstadt and Philip Linker. The track managers were not on to Linker's powers as a racer, and accordingly gave him a handicap of only a few yards. The others started even. Linker pulled ahead half way around the track and kept the lead to the finish, Langstadt second. For a prize Linker received a neat acetylene lamp. The time was 1:24. In the second heat C. Schuchardt entered, but was made to go around the track once by himself to equalize matters. He finished first in the heat, Foster second. Time 1:32. The winner received a pair of bicycle hose. While the contestants were resting, a fat man's race was got up between Jim Wolff, Tom Ferris and C. H. Pearce. Pearce, who weighs 260 pounds, won easily. Next came a slow race which was won by T. J. McGill. The third heat was also won by McGill, with McMasters a close second. Both received prizes. This ended the fun and the visitors returned to town.

On Wednesday evening the visitors boarded a special train of trolley cars, which was handsomely decorated, and went to the North Side. On the return trip a stop

was made at the power house and the machinery and cars were inspected. Then they proceeded to the works of the Brush company, after which they inspected the plant of the Edison company. After these places had been visited the party went to the Germania Hall, where they were pleasantly entertained by the Deutscher Verein. Mayor McCord was introduced by Mr. Copeland and welcomed the visitors with a short address. This was followed by an address by President George B. Rose of the Verein, after which Secretary Mercein of the Northwestern Electrical association made a short speech in behalf of the association. Other addresses were made by J. V. S. Church, George Cutter and Attorney C. H. Schweizer. Frank L. Perry responded for the "Electrical Press." The programme consisted of musical selections by Langstadt's orchestra and delightful vocal selections by J. R. Kerr.

Colonel Copeland's launch party on Thursday afternoon was pronounced the success of the convention. The colonel acted as commodore, and embarking on his magnificent Upper Mississippi river squadron of twelve launches about 5 P. M., the entire association left for a seven-mile cruise up the Mississippi. During the ride up the river the squadron was saluted time and again from the residences on the river banks, which remind one very much of the Palisades on the Hudson. After a most delightful ride a landing was made at a charming glade on the west shore, where Colonel Copeland had prepared a most bountiful spread. During the supper a photographer was on hand to photograph the banqueters at the tables, with the beautiful river view to the south as a background. At the termination of the meal, Secretary Thomas R. Mercein was again voted toastmaster, and a great number of happy responses were brought forth from the banqueters. The squadron returned to La Crosse about 8:30, and during the return trip was saluted by fireworks from the river banks as the fleet sped homeward. This ended what was generally voted to be one of the most successful of the Northwestern conventions.

Convention Notes.

Charles Henry Bunting, representative of the *Daily Republican Leader*, made a faithful report of the proceedings.

L. W. Kittman of the Chicago General Fixture company of course came in time to join the parties of the association.

"Champion" Doherty of Madison, Wis., and incidentally of the anti-Municipal Control league, was there in "full feather."

True to his custom for many years, Herman Andrae of Julius Andrae & Sons company, Milwaukee, appeared and was warmly welcomed.

The Fort Wayne Electric corporation made no exhibit, but its representative, E. F. Kirkpatrick, did the honors in true Fort Wayne style.

L. B. Howarth of the Electrical Engineering company of Minneapolis put in an appearance and kept his progressive company well to the front.

Of course J. M. Hill, western manager of the Bryan-Marsh company, was on the scene. Mr. Hill is one of he most popular men of the Northwest.

H. J. Gille of the Washburn & Moen Manufacturing company accompanied the St. Paul contingent and distributed a handsome pocket hand-book as a souvenir.

The enterprise of President P. C. Buros and General Manager Dodge of the American Electric Telephone company was the occasion of remark by many in a most complimentary manner.

The Crouse-Tremaine Carbon company of Fostoria, Ohio, was represented by John S. Maurer. The company is one of the most aggressive in the country, and there is never a convention at which it is not represented.

George Cutter of Chicago added new laurels to his already high reputation as an after-dinner speaker. Mr. Cutter was almost "caught napping" at the Germania Hall entertainment, but he nobly responded to a call on such short notice.

The careful and conscientious work of Henry D. Goodwin, the official stenographer of the Northwestern association, was greatly appreciated by the newspaper men in attendance. It is a pleasure to congratulate him on the efficiency of his service.

T. Julian McGill of Chicago extended courtesies on behalf of the Siemens & Halske Electric company of America. If Mr. McGill continues to make friends at the rate started at this convention his company hereafter will have to give him a private car.

Western Manager Joseph H. Cooke of the Buckeye Electric company, who also handles the Jandus arc lamp, made an interesting exhibit of Buckeye lamps and also presented the Jandus arc lamp and alternating and direct-current lamps in various designs. Mr. Cooke always makes a host of friends by his unfailing courtesy, and no one is more welcome than he at every convention

One of the most interesting displays was that of the American Heating corporation, in charge of F. P. Luther of Chicago, manager of the western department. Mr. Luther exhibited cooking irons, kettles, curling irons and other household articles, all for heating by electricity.

G. B. Foster, representative of J. Holt Gates, was in attendance during the meeting and made himself felt generally. Mr. Foster took pleasure in reminding those present that Mr. Gates had been recently appointed agent for the Wagner Manufacturing company of St. Louis at Chicago.

Thomas R. Mercein was voted great credit for his compilation of central station reports. These reports were from Illinois, Michigan, Nebraska, Indiana, Minnesota, South Dakota, Iowa, Montana and Wisconsin, and bear upon economic questions relative to electric light plants in that territory.

That energetic and progressive northwestern supply house, the People's Electric company of Madison, Wis., was in force and made an interesting exhibit. President F. H. Ford and Secretary C. W. Bacon were at all times on hand to do the honors to their large contingent of friends at the convention.

Clarence A. Ross appeared for the Sawyer-Man Electric company. This is the concern so well known as the manufacturer of the old Sawyer-Man lamp. The reputation of the lamp attracted a number of delegates to this exhibit, where the representative of the company furnished all the information desired.

George S. Whyte of the Leschen-Macomber-Whyte company was there. And "Whyte" proved himself to be an excellent host. In the train and elsewhere Mr. Whyte had a fund of stories, and as a prince of good fellows shows himself to be a fit companion for "Count de Wolffski" and "Viscount Wilhelm Lowdus."

This time a new company appeared on the scene, the Zamel Arc Light Meter company, and it was represented by its president, C. C. Schumacher. Mr. Schumacher presented a Zamel arc light meter and electric current timer. This is a valuable article in the hands of central station men, and its merits should be investigated.

The electrical journals were represented as follows: *American Electrician*, New York, W. R. C. Smith; *Electrical Review*, New York, C. E. Kammeyer; *Electrical World*, New York, J. V. S. Church; *Electrical Engineering*, Chicago, F. DeLand; *Electrical Engineer*, New York, W. P. Sullivan; WESTERN ELECTRICIAN, Chicago, F. L. Perry.

Secretary Thomas R. Mercein is certainly one of the most accomplished toastmasters, it is safe to say, throughout the Northwest. His remarks, always witty and to the point, yet never such as to excite other than pleasurable comment, would seem to indicate that he is fitted for even a more prominent position than that which has been from year to year gladly voted him by his host of friends in the Northwestern association.

It is said of Western Manager James Wolff of the New York Insulated Wire company, that during this midsummer convention he added a great number of new friends to his already large list. In fact, Mr. Wolff "did himself proud"—this time he excelled all previous efforts, and as "Count de Wolffski" proved himself a thorough man of distinction and a fitting companion for "Viscount Wilhelm Lowdus of Applianceski, Sweden."

Of course the Columbia incandescent lamp kept up its record and appeared in the person of Secretary and Treasurer A. C. Garrison. Mr. Garrison made a small but very interesting exhibit of the various materials used in the process of manufacture of the Columbia high-grade lamps. As the Columbia company is now recognized as one of the most careful and scientific manufacturers, it was an unusual attraction. Mr. Garrison distributed an attractive button, and as a sign of the Columbia lamp it was seen everywhere.

"Clarence" came up for the Commercial Electrical Supply company of St. Louis. On this occasion "Clarence" took the place of "Little Willie" and the "Old Man," and although not so handsome nor so frolicsome he did good work for the Commercial company. It was remarked that "Clarence's" photograph was so much admired that it now decorates one of the local desks in La Crosse, where it may be seen from the street. It was a matter of considerable regret that President Joseph Franklin, Jr., and Manager of Sales Paul D. Cable could not appear.

The Electrical Appliance company of Chicago was represented by its president, W. W. Low, assisted by Frank McMaster. The company exhibited a line of electrical soldering irons, also Highland soldering paste. An interesting feature of the exhibit was the sad-irons of the American Electrical Heater company, Detroit, under which the delegates had their neckties pressed and trousers creased. Another interesting and novel feature was Newgard's waterproof globe, which was shown with an incandescent lamp burning under water.

Colonel Copeland's token, presented to the association at the first day's meeting, was greatly appreciated. Colonel Copeland was assisted at the Germania Hall entertainment by his two charming daughters, who left nothing undone to make the social features of the convention a thorough success and a credit to La Crosse. Colonel Copeland's general and official entertainment committee was composed of the following gentlemen: Arthur Espersen, C. H. Greenwood, James Sheridan, Otto Langstadt, F. S. Walker, Peter Valier, I. Basset Knuteson, G. S. Stiles, J. W. Johnston and L. D. Richardson.

The *La Crosse Daily Press* showed its customary enterprise in appearing at Colonel Copeland's magnificent banquet on the river bank with a large supply of its evening edition, which was distributed, complimentary, to the large number of delegates that partook of the feast. City Editor E. Cole Burke was in attendance and responded to the toast "The City Press." It is a pleasure to state that the entire staff of the *La Crosse Daily Press* contributed to the pleasure of the visitors. W. S. Luce, proprietor, assisted by Ernest L. Tibbits, telegraph editor, particularly added greatly to the pleasure of the meeting.

The Electrical Supply company of Madison, Wis., was represented by L. W. Burch, its president, and H. C. Hackney. The display consisted of a full line of central station and construction material for both electric light and telephone systems. Special exhibits were made of Grimshaw and Raven core wires, American Marble company's tubes and insulators, Standard telephones, extension bells, Columbia lamps, sockets, switches and cut-outs. The display was neatly arranged and was very interesting. Mr. Burch reports unusual activity in the supply business. The company's new illustrated supply catalogue will be ready for distribution in about 10 days.

Of course the Central Electric company of Chicago was represented, Charles Burton and W. P. Upham doing the honors. Mr. Burton did not appear until Thursday, and it was a matter, too, of great regret that President George A. McKinlock was prevented from carrying out his previous intention of joining the Northwestern boys at La Crosse. Mr. McKinlock was expected, but other business upset his plans. The Central Electric company, as usual, secured a most prominent place among the exhibits. Lundell apparatus was everywhere in evidence, and the smooth-running Lundell electric fans made the display a most welcome one. A large and varied line of general supplies was presented.

One of the parlor exhibits was that of the Pacific Electric company of La Crosse, Wis., consisting of the Espersen adjustable shade lamps, of which the company makes 10 different styles; also the Espersen dental and surgical lamp, and the Espersen examination lamp for eye, ear, nose and throat work. All these lamps are made up in very handsome designs, and shade lamps are furnished to match the finish of the room in which they are to be placed. These lamps are greatly admired for their ease of adjustability and simplicity of construction. The company is introducing its shades throughout the country by means of establishing agencies as well as through the electric supply houses. The company was represented by Haskel Withee and Arthur Espersen.

The Peru Electric Manufacturing company was ably represented by F. D. Covington, who exhibited a full line of porcelain goods and batteries. One of the company's new specialties, which attracted considerable attention, was a porcelain primary cut-out. This specialty consists of an inverted cup containing a plug carrying a fuse. It is of ample capacity and thoroughly reliable. Another interesting feature of the exhibit were the Hercules batteries arranged with porcelain covers, which are very neat and prevent evaporation. The company also showed some high insulation triple petticoat porcelain insulators of a neat and serviceable design. All who examined this line expressed themselves as highly pleased with the advance made in this line by the Peru company.

The splendid exhibit of the American Electric Telephone company of Chicago received much attention and favorable comment. Connection was made with the exchange system of the La Crosse Telephone company and visitors were afforded opportunity of testing the new American long-distance solid-back transmitters. Among the novelties shown was a combined district telegraph and telephone call box, for which claims of great utility are made. The display of telephones was quite extensive and showed great perfection of detail; instruments were shown with cabinet-work of bird's-eye maple, mahogany, cherry, oak, walnut and birch. Late improvements were shown in switchboards, cabinet and desk sets, adjustable arm transmitters, generators, repeating coils and lightning arresters. General Manager H. C. Dodge was on hand to meet and extend a cordial welcome to all callers.

The Wagner Electric & Manufacturing company of St. Louis made quite an extensive exhibit of its advanced forms of alternating apparatus. Among the most interesting features was an alternating single-phase five horse power induction motor, a Wagner alternating current ceiling fan, a three horse power 110 volt direct current motor, a Wagner station voltmeter illustrating the company's most approved method of mounting on a marble slab. A "type D" 30 light converter was also presented, together with a varied assortment of the most improved Wagner switches, economy coils, fuse boxes, etc. It is perhaps needless to say that this very handsome exhibit was in charge of the Wagner company's popular manager of sales, E. H. Abadie. Mr. Abadie was greatly aided in his successful efforts for his company by G. B. Foster, representing J. Holt Gates of Chicago, who has recently been appointed an agent at Chicago of the Wagner company. Mr. Abadie was most energetic in pushing his meritorious apparatus, and the

fact that the Wagner company is one of the most advanced producers of alternating and direct-current apparatus in this country made the display one of the features of the convention. Mr. Abadie, too, is a man of great popularity, and as a consequence the Wagner exhibit was one of the centers of attraction.

One of the largest and most important exhibits at the convention was made by the Westinghouse Electric & Manufacturing company. It had a very desirable room adjoining the hall in which the meetings were held. One of the representatives of the Chicago office, Henry Floy, was on hand to extend the courtesies for his company. The company exhibited in operation a five horse power, 220 volt, slow speed, multipolar shunt motor. This is one of the standard machines of this company, which builds all its direct current machines of all classes with four laminated pole pieces and lathe wound, ventilated armature coils. The constant potential, alternating current arc lamp shown in operation proved how satisfactorily this type of lamp meets the demand for an alternating current lamp that may be operated from constant potential circuits. The lamp is very handsomely finished and would be an ornament to any store or private dwelling. The lamp consumes 15 amperes at 26 volts. The new Shallenberger integrating wattmeter was also shown in operation, demonstrating its ability to fulfill the guarantee which accompanies these meters, namely, to start on one-half of one per cent. full load current and to register accurately on all loads, whether of an inductive or non-inductive character. A number of instruments were shown, as lightning arresters of the non-arcing type for both direct and alternating current circuits. The Westinghouse company has made an improvement on the direct current line arrester which makes it much less liable to become short-circuited by water or from other causes. This arrester has been extensively used throughout the country and the improvement here mentioned will no doubt add to its popularity.

The General Electric company was represented by F. N. Boyer, manager supply department; Thomas Ferris, representative in Wisconsin, and R. A. Swan, meter and transformer department. The exhibit of this company represented the latest improvements made in the lighting field and comprised a full line of instruments for measuring current. The instruments are for station switchboard, portable and pocket use. The portable instruments are of the inclined coil type. The type H transformer is represented by a 1,000 watt instrument, which displayed the latest development in winding and arrangement of cores. The new connecting board contained the improvement made in arranging for the change of secondary voltages. The full line of watt meters which was displayed received considerable attention, as the instruments showed a considerable range of voltages and uses. The meters are manufactured for 50 or 100 volts on two-wire systems, 220 volts for two or three wire, 500 volts for stationary motor work. One of the principal features of late developments is the 500 volt street car meter. This meter is specially designed for street car service and is for the purpose of permanently fixing on individual cars, so that street car managers can determine the amount of energy consumed in watts per car mile for any one trip or length of time. The arc lamp display introduced the long-burning inclosed arc alternating lamp. This lamp is simple in design, artistic in appearance, durable in construction, and the mechanism is not likely to get out of order. The lamp is arranged by means of a reactance coil to carry any voltage from 100 to 120, and can be adjusted for any frequency with a long life at the greatest possible economy. The other lamps on exhibiton were of the single-solenoid type of 80 volts at the arc, taking from three to five amperes with a life of 100 hours. These lamps are unique in design, with a case that is artistic in construction. The lightning arrester displayed is of the latest Wirt type and is similar in design to those installed at Niagara Falls, where they secured the first place after severe competition, taking care of the heaviest electrical discharges. The General Electric company received many congratulations upon its excellent display.

Controversy Over Street Railway Fare in Indianapolis.

In the controversy as to the validity of the law passed by the recent Legislature reducing the street railroad fare in Indianapolis from five cents to three cents, the United States Circuit Court refuses to give way to the Supreme Court of the state. As soon as the law went into effect the Citizens' Street Railroad company secured from Judge Showalter of the federal court an injunction against its enforcement. It was held by the judge that the law was invalid by reason of being special legislation, no other city in the state being affected.

The attorney-general for the state took the case before the state Supreme Court, which held, unanimously, that the law was constitutional. It was then urged on the part of the state that it was the duty of the United States court to follow the decision of the state court, as the question was one that concerned the people of the state only, and Judge Showalter was asked to modify his original opinion so as to make it conform to the decision of the state court, and dissolve his injunction against the enforcement of the law. In his opinion, announced on July 22d, the judge refuses to modify his first decision, and for the second time points out that the law is unconstitutional. He bases his decision upon two points, one that the law is special legislation and the other that it seeks to abrogate a contract between the city and the street railway company. He declares that when a federal question is involved the decision of the highest court of the state is not final, but is reviewable by the Supreme Court of the United States. To that extent, he says, the judicial power of the state is subordinate to that of the United States. On the point that the law proposes to abrogate a contract, and is, therefore, in violation of the federal constitution, he points out that it is provided in the company's charter, granted in 1861, that it shall have the power to fix the fare to be charged, so long as it does not exceed five cents.

The disposition of the patrons of the street railroad is to recognize the decision of the Supreme Court of the state as the law. Under the injunction the officers and employes of the street railroad are restrained from collecting other than five-cent fares, but the patrons, it is pointed out, are not restrained from tendering a three-cent fare.

The law provides that the company may be liable for a civil penalty of $100 for every passenger it charges a fare in excess of the three cents, and now it is proposed by patrons to tender the lower fare, and upon its being refused to bring suit for the penalty. In anticipation of this move the attorneys for the company went into the United States court on July 22d and asked for an order to restrain persons who brought suits before the injunction was issued from prosecuting them. A movement is on foot to organize companies of 25 or more which shall tender the lower fare and demand rides free unless it is accepted. Under such conditions, it is pointed out, the company will be at the mercy of the patrons. It is announced that the decision of Judge Showalter will be appealed from the Circuit Court to the Supreme Court of the United States as soon as the final decree shall have been entered.

Street Railway Monopoly.

[From the *Chicago Chronicle*]

Reliable information is to the effect that a movement is on foot to create an enormous street railway trust, which will have ramifications in all the leading American cities, and which will manufacture in its own factories the electrical machinery necessary to equip its hundreds of different lines.

The street railway lines of Philadelphia and Pittsburg have already been consolidated by the prime movers in the new traction trust, and the street railways of New York, Boston, St. Louis and Chicago are in process of consolidation by the same methods as fast as independent companies can be bought out or forced from the field.

The principal organizers of the new traction trust are reputed to be fabulously wealthy and to have practically unlimited resources from which to draw the capital requisite to swing so vast a project. The local traction magnate, Charles T. Yerkes, and his earlier Philadelphia associates, Widener and Elkins, are said to be prime movers in the enterprise, but the list of backers also includes a score or more of other capitalists prominently identified with railway, electrical and other industrial enterprises in America and abroad.

Street railway transportation comes, if possible, nearer to the pockets of the great masses of the people than any other single commodity. It cannot be monopolized without detriment to the people, and the latter, being the owners of the streets, are themselves forging the chains that bid fair to bind them to slavery.

Recent legislation in this state proves the power of monopoly when allied with corruption as against the rightful demands of the people who elect representatives and senators only to be betrayed by them. The history of all trusts is plentifully strewn with corruption, but it is rarely that the plotters exhibit the boldness that has been witnessed in Springfield and Chicago recently in relation to street railway monopolies.

It was claimed in defense of the Standard Oil trust that the price to the consumer was lowered, and the magnates of the sugar trust have always maintained a similar attitude when pleading for more protection. In monopolizing street railways the plotters make no attempt at such flimsy pleas, and deliberately propose to maintain indefinitely an arbitrary rate of fare.

Five cents for a street railway ride may have been cheap twenty years ago, but it is nearly double what it should be when compared with the lowering of other commodities. The sole reason for a traction trust is to keep opposition companies from the field at any cost and to pile up colossal fortunes for the large stockholders by charging about twice what the service is worth.

Locally, there are indications that a determined stand may yet be made against the rapacity of the street railway monopolizers. The next Legislature should have a majority in both houses pledged to repeal the Yerkes-Allen law, and if Mayor Harrison remains true to his present course he may render it impossible for corrupt aldermen to sell out the people to the traction trust in advance of such a repeal.

Niagara Power.[1]

By L. B. Stillwell.

Sixty-eight years ago M. Guizot, professor of history in the faculty of literature at Paris, delivered a remarkable course of lectures upon the general history of the civilization of modern Europe. In the introduction to these lectures he divided the facts and forces which operate to advance civilization into two classes: First, those which help to shape the history of a nation by influencing society as a whole—"its institutions, its commerce, its industry, its wars, the various details of its government;" and, second, "certain facts which, properly speaking, cannot be called social—invididual facts which rather concern the human intellect than public life; such are religious doctrines, philosophical opinions, literature, the sciences and arts." These latter forces, he says, "seem to offer themselves to individual man for his improvement, instruction or amusement, and to be directed rather to his intellectual amelioration and pleasure than to his social condition. Yet still," he continues, "how often do these facts come before us—how often are we compelled to consider them as influencing civilization. In all times, in all countries, it has been the boast of religion that it has civilized the people among whom it has dwelt. Literature, the arts and sciences, have put in their claim for a share of this glory, and mankind has been ready to laud and honor them whenever it has felt that this praise was fairly their due."

I invite your attention to this quotation not because the facts and forces referred to were at the time sketched in anything but their true relative proportions, not because Guizot's perspective was incorrect for the year 1829, but because the perspective of his picture was at that time true, and because since that time one of the forces to which he refers—then in the background—has grown into the very foreground of every true picture of the forces contributing to modern civilization which can be painted to-day. A few years after these lectures were delivered, the first steam locomotives in England and America were put into operation. In 1831 Michael Faraday observed that a copper disk revolved in the field of a magnet was traversed by an electric current, and now, within the short span of a scriptural lifetime—three score years and ten—engineering science, by steam and electricity utilizing natural forces practically unobserved throughout all the long centuries preceding, has effected a greater change in man's social condition and has, perhaps, done more to promote civilization than any other civilizing force. In the history of civilization what a place must now be given to the art of steam engineering—the applied science of thermodynamics—not as "rather concerning the human intellect than public life;" not as "offered to individual man for his improvement, instruction or amusement;" not as "directed rather to his intellectual amelioration and pleasure than to his social condition;" but, on the contrary, as profoundly affecting social conditions by cheapening the necessities and comforts of life, by reducing the hours of labor and by imparting an almost incalculable stimulus to intellectual activity in every direction. And what a place must now be accorded to applied electrical science—covering the earth with lines of instant communication, bringing all lands into touch; lighting the dark places in our cities; doubling areas available for suburban residence, separating the very molecules of matter into their constituents, or forming new compounds; and now beginning to turn the wheels of industry in hundreds of factories and mills.

It is unnecessary to demonstrate to this audience that well distributed acquisition of material wealth is desirable and tends to advance civilization. It will be conceded at once that a wise and not wasteful utilization of natural forces, cheapening the cost of power for a community, is praiseworthy. We all believe that there is in the universe a certain fixed quantity of matter which we are powerless to increase or decrease, and we accept the doctrine first fully ennunciated by Helmholtz, that Nature provides also a fixed quantity of energy, to which we can add nothing and from which we can take nothing away.

A man, considered as an engine and compared with the vast supplies of energy available in coal and falling water, is capable of but an insignificant amount of work. It has been calculated that a very strong man exerting himself very violently, can, for a few minutes, work at a rate approximating one-fifth of a horse power, but we have only to remember that one-fifth of a horse power means 6,600 foot-pounds per minute and that this is equivalent to lifting 110 pounds one foot every second, to perceive that the calculation does not apply to the average man performing continuous work by the hour. Considering work continued for 10 hours per day, I think it is safe to say that the average output of 50 strong laboring men working steadily and faithfully would not exceed one horse power, and it is probably no exaggeration to say that the power of Niagara exceeds the physical power which the whole human race is capable of continuously exerting.

Niagara is a great solar engine. You all understand the cycle. Water raised by the sun from sea and lake and river is precipitated to the earth by changes of temperature, finds its way way into the great lakes and thence by the Niagara River to the rapids above the falls, more than 200 feet above the level of the water in the gorge immediately below the cataract. To raise a pound of water from the river below the gorge to the head of the rapids, a force of one pound must be exerted through a distance of, say, 200 feet. Therefore, every pound of water at the upper end of the rapids

1. Lecture delivered at the Niagara Falls convention of the National Electric Light association, June 9, 1897.

represents 200 foot-pounds of energy, which are given up in falling to the lower level. The rate of flow exceeds 7,000 tons of water per second, and the total horse power is estimated (by the United States census of 1880) to exceed 5,800,000. That is an enormous amount of power. Let us see how much coal we should have to burn to develop as much. A committee of the National Electric Light association several years ago made a systematic effort to ascertain the economy in the consumption of coal obtained in electric light stations throughout the United States. The final report of this committee is not before me, but the preliminary report submitted at the convention in St. Louis, March 1, 1893, showed that the average consumption of coal in these stations per horse power hour, measured, as I understand, by electrical measuring instruments on the switchboard, slightly exceeded six pounds. At this rate it would be necessary to burn more than 130,000,000 tons of coal per annum to develop power equal to that of the Niagara River from the upper limit of the rapids to the gorge below the falls. This would be substantially one-third the coal product of the world, and would materially exceed the entire amount of coal now used for power purposes. With the best of modern steam plants the consumption of coal would still exceed the entire annual output of the anthracite coal fields of Pennsylvania. Making all necessary allowance for loss in an hydraulic plant the power of Niagara Falls, if it could be utilized as a whole, would supply more than 3,000,000 arc lamps of 2,000 nominal candle power each. An idea of what that number means may be obtained by imagining a row of arc lamps on either side of a railway track extending from New York to San Francisco. Were the number named available, 2,000 candle power power lamps might be located on either side of the track at intervals of 12 feet throughout the entire distance. Expressed in terms of 16 candle power incandescent lamps, there is sufficient power to drive 600 generators like those now installed in the power house of the Niagara Falls Power company, each of which supplies energy equal to that required by about 75,000 50 watt lamps, or, to put it still another way, the power of Niagara, if used for the refining of copper by electrolysis, would deposit more than 2,000 net tons per hour.

There is an important difference between using the energy of coal and utilizing the energy of water powers for power purposes. Coal once burned cannot be used again. Water powers, on the other hand, are solar engines perennially renewed. We may utilize the energy of Niagara to-day without subtracting a single horse power from that which Nature intended not only for our age, but for future ages. The thought, therefore, immediately suggests itself that we should so far as possible utilize our water powers in the mechanic arts, burning coal only for our protection from cold, for the preparation of food, for necessary metallurgical purposes, etc. If this be impracticable, we should at least see to it that our utilization of the energy of coal does not involve undue waste.

Of course, not all of the power of Niagara can be utilized. Aside from esthetic considerations, which will, perhaps, for all time prevent the utilization of a sufficient amount to impair the beauty of the falls, and considering the subject simply as an engineering problem, large deductions from the figures here named must be made to cover the difference between the total and the effective head, this difference representing the fall in canals and tunnels conveying water to and from the wheels. I suppose that it would be possible to deliver about 4,000,000 horse power to the turbines, and of this amount the turbines would deliver about 3,200,000 horse power at their shafts.

At this point—the shaft of the turbine—engineering science for a long time halted. Water wheels appear to have been used at least 2,000 and probably 4,000 years ago, though not extensively. Every water wheel necessarily had a shaft upon which it was supported and about which the blades revolved. The problem was how might the power be conveyed from the shaft to a point where it could conveniently be made to do work. Naturally enough, men first used for this purpose something which they could see and handle and readily comprehend. They used wooden shafts, then ropes and belts. Then someone thought of using a liquid, and the science of hydraulics began. Still later somebody suggested using a gas, compressed air, and pneumatic transmission attempted to solve the problem.

When the officers and directors of the Cataract Construction company came to decide what methods of developing and distributing the power of Niagara should be adopted, they faced a problem of transcendent importance. It involved far more than the mere capital to be invested; it involved, in no small degree, the future development, the prosperity of a territory bounded by a circle having for its radius the utmost distance to which the future advancement of engineering science might make it possible to transmit power, and the decision of the company carrying out to a conclusion a project inaugurated on so vast a scale, occupying so conspicuous a position in the eyes of the scientific and engineering world, must inevitably exert a powerful influence upon the great world problem of the economical utilization of our supplies of natural energy. To utilize and distribute over the widest range, with the least waste, with the greatest certainty, and in form adapted to the widest variety of applications—these were the conditions to be met. To enumerate them now is to suggest to all our minds, with absolute certainty, electricity, the Proteus of engineering science as it exists today, but it must be remembered that when those who inaugurated and have thus far carried out the project, began their study of the problem, the possibilities of electricity had not been demonstrated and recognized as they are to-day. At that time the relative advantages and the limitations of water, air, rope transmission and electricity were less evident than now, and it was necessary to examine with great care and weigh with accurate judgment the merits and defects of many different plans This the company proceeded to do with remarkable patience, thoroughness and ability, inaugurating a competition which many of the most prominent engineers and manufacturing firms of Europe and America were invited to enter, and offering prizes for the best solution of the problem. The question was in no sense begged at the outstart. The company did not select electricity because it was the newest agent for transmitting power, nor because the general public was, as it still is, disposed to assume that electricity is necessarily the agent best adapted to the solution of every engineering problem. They arrived at their decision to use electricity only after several years of investigation, in which, practically without regard to cost, they endeavored to secure the best of engineering talent, and in which they allowed no prejudice and no difficulty to narrow or limit their cosmopolitan search for the best solution.

Let us consider very briefly some of the limitations to which our various methods of transmitting power are subject. For obvious reasons, transmission by shafts, ropes and belts is effective and efficient only over comparatively moderate distances. A shaft, for instance—even a hollow shaft—if strong is necessarily heavy. It must be supported and carefully aligned. To effect a change in the direction of transmission special devices, such as gears and pulleys, must be used. All this means loss of efficiency at every step, and the economical limit is soon reached. In the case of transmission by ropes or cables, also, loss of efficiency results from the necessity of supporting the weight, and sharp turns are difficult to make and imply heavy losses. Subdivision by shafts or cables can be mechanically effected only by the interposition of pulleys, gears and similar devices, all of which consume energy, and therefore imply waste.

Hydraulic transmission is also limited to comparatively short distances. Under certain conditions and for distances not exceeding two or three miles it is used with good results. The municipality of Geneva, Switzerland, under the able direction of Col. Theodore Turrettini, foreign consulting engineer of the Cataract Construction company, has established an hydraulic plant for the distribution of power throughout that city, which has been splendidly successful and is worthy of most careful study. Col. Turrettini and the municipality of Geneva, however, recognize the superiority of electric transmission over distances exceeding a very few miles, and they have more recently constructed a second power plant some four miles farther down the Rhone, in this case using electricity to transmit and distribute the power.

Some of the causes which limit the distance to which power can be economically transmitted by water will readily occur to you. For example, the amount of power transmitted through a pipe by water under pressure is proportional to two things: the quantity of water which flows through the pipe in a given time and the head or pressure. Friction increases with pressure, and also with an increase in the length of the pipe. Then the efficiency of water motors, particularly those of comparatively small output, is low as compared with that of electric motors. Again, the chance of water freezing in the pipes must be considered, and a limitation not frequently encountered in practice, but still worthy of note, results from the fact that water, unlike electricity, has weight. If we were to undertake to carry a pipe line filled with water over some of the mountain ranges now crossed by electric conductors, we should have a pressure in the pipe, at certain points, of not less than 1,500 pounds per square inch, due to the greater elevation of other parts of the line.

The limitations of pneumatic transmission have not been accurately determined, and it is probably possible to obtain better results by this means than have as yet been realized in practice. Air compressors, however, have been made for many years and, as compared with electric generators, are much less efficient. To compress a gas means necessarily to develop heat, and this, so far as our purpose of transmitting power is concerned, involves loss; and while it seems probable that by using very high pressures in pipes of comparatively small diameter, the cost of a system transmitting by compressed air may be much reduced as compared with present practice, there are serious difficulties to overcome, and up to the present time no satisfactory method of surmounting these difficulties has been demonstrated.

The fourth solution of the problem of transmission is by electricity. That is, by the ether under unbalanced pressure. Note, if you please, the interesting sequence of the several solutions of this problem of transmitting power: First, a solid, then a liquid, then a gas, and finally something (if I may use the expression) more volatile, more subtle even than a gas; something which, in itself, we can neither touch, taste, smell, hear, nor see; something which we know only by its effects; something so elusive that for centuries the world did not know that it existed. Is it not significant of the progress of engineering science that it should thus have advanced from those agents directly perceptible to our senses to one which our physical senses cannot perceive; from the material to the immaterial?

And now what is ether? What is electricity? And how is power transmitted by electricity? These are questions which the science of the present day cannot fully and satisfactorily answer. But we are not totally ignorant of the nature and characteristics of this agent which we are using with such confidence and assurance of results, and it is not difficult to form in our minds a rough conception, useful as a working hypothesis, though not susceptible of proof, and very properly subject to criticism from various points of view. We know from optics that there is a medium which is not a solid, not a liquid, and not a gas. We may exhaust the air from a glass vessel and light will still pass through it. Air, therefore, is not the medium by means of which light is transmitted. Evidently, there is something still in the glass vessel which serves to convey the ray of light. We know, also, that the space between the earth and the sun is not filled with air, and yet it is traversed by light. We assume, therefore, that the interplanetary spaces are filled with this same something, and for convenience we call it ether and proceed to study its phenomena. The science of optics, which deals with the propagation of light through this medium, is so well established by observed facts and by general theories which explain and inter-connect these facts, that practically nothing within the range of human knowledge is more certain than that something which we call ether does exist and that it pervades all space and all matter. In 1888 the German physicist, Hertz, proved beyond the shadow of a doubt that electric and magnetic phenomena have to do with this same medium.

Electricity is defined as ether in a state of strain, or, more properly speaking, in a state of unbalanced strain, this strain manifesting itself along the conductors of an electric circuit connected at one end to a dynamo in action and at the other end to a lamp, motor or other translating device. Prof. Lodge advises us to conceive of an electric conductor as a hole through the ether. The static balance of the ether being relieved or unbalanced along the surface of the conductor, and the strains to which our world of ether is subject (somewhat as water at the bottom of the sea is under pressure) being unbalanced along the line of the circuit, the ether transmits along the surface of the conductor the strain or pressure imparted to it by the dynamo. We need not pause to consider whether the strain is transmitted by the ether within the copper conductor or along its surface, but we may imagine that following the path of the conductor from the dynamo to the motor and back again from the motor to the dynamo, a loop or chain of ether transmits a stress or strain from the dynamo to the motor somewhat as a belt conveys power from a driving to a driven pulley.

In the telegraph, and more recently in the telephone, we have become familiar with some of the characteristics of electric transmission, notably the fact that it is practically instantaneous in its action. We press a key in America and the mind of an operator in England almost instantly has our thought. The mechanical movement of the transmitting instrument here causes a mechanical movement of part of the recording instrument there. It is as if they were connected by a rigid bar less compressible than steel, yet weighing nothing.

We are less familiar with the fact that electricity is strong, but observation of thousands of street railway cars driven at high speeds and up heavy grades, and of motors operating heavy machinery in mills and factories, is teaching us this also. As a matter of fact the power transmitted through a copper conductor of given section, at the potential now being employed by the Niagara Falls Power company in transmitting power to Buffalo (between 10,000 and 11,000 volts), is sufficient to break many steel cables of equal section moving 10 miles per hour and attempting to transmit equal power. At 10,000 volts a single-phase circuit consisting of a copper conductor one inch in section and carrying 1,000 amperes, transmits more than 13,000 horse power. The strain upon a cable transmitting this amount of power mechanically and moving 10 miles per hour would exceed one million pounds, enough to break eight steel cables one inch in section and having the high ultimate tensile strength of 125,000 pounds per square inch. In three-phase transmission, such as is used between Niagara and Buffalo, the results in this respect are still more remarkable, but to consider three conductors makes our comparison with a steel cable less evident.

Power transmitted by electricity is delivered in a form adapted to a remarkable variety of uses and, as compared with power transmitted by any other system, possesses important advantages. Supplied to a motor, it performs mechanical work at efficiencies ranging from 60 to 95 per cent., depending upon the size of the motor. Delivered to an arc lamp, it produces from 1,500 to 2,000 actual candle power per horse power. Used to supply incandescent lamps, it produces light agreeable in quality, possessing substantial advantages over other forms of illumination, and developing from 200 to 250 candle power per horse power. Conveyed to the terminals of the electric furnace, it produces, by synthetic process, various materials new in the arts and of great value, or, traversing the electrolyte of the chemist, it tears apart the very molecules of which matter is composed and segregates their constituent elements. Unlike shafts, belts and cables, it can be indefinitely subdivided without material loss. It can readily turn corners. It is transmitted vertically with as much ease as horizontally. Unlike water, it never freezes, and unlike compressed air, it can be delivered from the generating machinery and transmitted many miles at very high efficiency.

And now how is the Niagara Falls Power company proceeding to develop Niagara power under the grants which it has received from the state of New York and the province of Ontario. The plans have been so often and so fully described that I do not propose to consider them in detail. In general, however, I desire to invite your attention to certain facts connected with the work and to certain features of the plans and the methods of construction adopted, which demonstrate, I think, that the Niagara Falls Power company thoroughly under-

stands the magnitude and far-reaching consequences of its project; that it is carrying out the project with remarkable skill and courage, and with an evident desire to build not only for the present, but for the future; and that it aims not only to secure a fair return upon the capital invested, but to insure to the entire country, within the rapidly receding horizon of practical power transmission, the advantages which should result from the possession of this wonderful gift of nature.

CORRESPONDENCE.

New York Notes.

NEW YORK, July 20.—To an inquiring reporter the general manager of the Manhattan elevated railway system declared yesterday that the third-rail system was being carefully watched for improvements, that it was favorably regarded even now, and that in all probability it would transmit the motive power for the road in the future, but he could not say how near at hand the time might be before the system would be equipped with the third rail.

The Appellate Division of the Supreme Court in New York city yesterday announced the appointment of three commissioners to take testimony and to report to the court whether the new rapid transit route, as last planned by the Rapid Transit commission, ought to be constructed. The commissioners appointed are Arthur D. Williams, John Sabine Smith and Algernon S. Frissell. Messrs. Williams and Smith are well-known lawyers. Mr. Frissell is president of the Fifth Avenue Bank.

Passengers in a Putnam avenue trolley car in Brooklyn last week saw a practical application of the power of electricity that made them open their eyes wide. One of the city ash carts, loaded nearly to the top, had found a soft place in the mud between the boulders which do for pavement in many of the streets, and both hind wheels had sunk in almost to the hubs. Four powerful horses were attached to the cart, but could not budge it an inch. When the car came along it was concluded to test its power. A chain with hooks was used to hitch the wagon to the car. The motorman turned the current on almost imperceptibly, and though the pull was a diagonal one, the cart being next to the curb, the wagon was drawn out of the hole easily and without a jolt.

The transportation companies are having considerable trouble, as usual, over the tax assessment. The Manhattan Railway company has obtained from Justice Truax of the Supreme Court a writ of certiorari to review the assessment for the current year on its real and personal property. The tax commissioners assessed the realty at $27,553,000 and the personal property at $1,700,982. The road contends that its realty should be assessed at only $9,226,804.80, and that no personal tax should be imposed. The value of the realty, according to the company's figures, is $15,378,008, as shown by the cost of purchase and construction, as follows: Metropolitan line, $7,413,995; New York lines, $5,341,960; joint lines, $993,802; suburban lines, $1,534,996; signal and telegraph system, $16,656, and docks north of 159th street, $76,599. This total, it says, should be assessed at only 60 per cent., as other property is assessed on that basis. The company says its total assets amount to $26,003,851, its bonded indebtedness to $39,598,035, and unpaid judgments $1,193,193. Besides, it is asserted that there are 2,590 actions pending against the company, involving many millions of dollars, and in which judgments will probably be secured against the company for about $3,000,000. In 1895 the company was assessed for $13,540,700.

Commissioner Collis gave a hearing yesterday on the application of the Metropolitan Street Railway company for permission to begin the work of changing the motive power of the Madison avenue street car line to electric power. One of the opponents of the application made the curious assertion that, upon Madison avenue, the change from animal power to electricity would, without restrictions, depreciate property values. Commissioner Collis said that he should like to have the Metropolitan company file a map at his office, showing the existing tracks and the way in which the applicant proposed to cross the Third Avenue company's tracks, or, after getting downtown, how it proposed getting back to Center street. The Third Avenue people might see the map. Until it was filed he would stay his hand. He made clear during the hearing his wish to have the work that was to be done, done this season, as he didn't propose, he said, to allow the streets to be torn up in the winter.

Inspectors appointed by the Board of Health to count the number of passengers carried on the principal lines of the surface roads in this city report overcrowding of cars in every instance. On one day, during two hours when the traffic was greatest, the inspectors reported that 1,750 passengers were standing in 135 north-bound open cars. There were 35 passengers standing in one of these cars, the greatest number counted in any one instance. Three hundred and sixty-one passengers were standing in 56 cars that went north past Seventh street on Third avenue the same day. Thirty more open cars that passed on Sixth avenue at Twenty-third street during two hours had 200 passengers standing. On the main Broadway line at the same point 71 open cars passed with 668 passengers standing. The most crowded car had 28 standing passengers. At Eighth avenue and Fifty-ninth street during two hours 29 open cars passed with 223 passengers standing. Commenting upon the condition of affairs thus disclosed, the *Herald* says: "It is bad enough when five persons are squeezed into a seat designed for four on an open car, but when the narrow spaces between the rows of seats are wedged with standing passengers who haven't even a strap to cling to, and the side steps and platforms are crowded, the result is a nuisance that is dangerous as well as annoying, and one that is not tolerated in Paris, London and other large European cities." It is suggested that the Common Council pass an ordinance requiring that no more passengers be taken on a car when every seat is occupied, as is the practice abroad. Such a rule might be unpopular with those who would rather squeeze into a packed car than not get on at all, but it would at least enforce the right of every passenger to a seat. Moreover, it would prove a most effective means of bringing about the running of more cars. M. S.

New England News.

BOSTON, July 20.—After a formal conference between the Board of Railroad Commissioners and the Boston Elevated Railway company, the latter filed an application with the board for authority to issue $15,000,000 of the $20,000,000 capital stock authorized by the elevated railroad act of the last General Court. The application was signed by President William A. Gaston. The petition states that the issue is asked, under the statutes passed by the General Court, to construct its road upon a route of not less than seven miles in length, and, in addition, to construct its railroad between Brattle square, Cambridge and its lines in the city of Boston. The commissioners will give a public hearing on the petition to-morrow.

A. H. Overman, the bicycle manufacturer of Springfield, who was elected president of the Boston, Quincy & Fall River Railway company during his absence from the city, has resigned. This is the bicycle road of which E. Moody Boynton is the inventor and for which a charter was granted by the last Legislature. Mr. Overman, in his letter, says that he thoroughly approves of the one-wheel system for railways, but cannot give his time to the presidency of the road.

The affairs of the United Telegram company have been given a further airing in the United States Circuit Court before Judge Colt. The case of William H. Baker of Brooklyn against the United Telegram company and its officers, Robert F. Straine and Charles A. Lamson, in which Marsden J. Perry was appointed receiver, was before the court upon an application made by the plaintiff, asking that the receiver be ordered to sell 6,500 shares of stock in the company which were pledged with it by Straine to secure the payment by him of an indebtedness of $72,000, which he owes to the concern. This suit was originally brought by Baker, who is vice-president and general manager of the Postal Telegraph company and a stockholder owning three shares in the defendant company, and also as a bondholder owning $113,000 of its bonds, asking for the appointment of a receiver, and that the defendants Straine and Lamson be enjoined from acting as officers of the company, alleging that they had improperly managed it. The case arose out of internal differences in the company. Some weeks after it was brought the parties to it entered into negotiations to settle their differences and reach some sort of an agreement, which they tried to carry out, and which they believed they had perfected until afterward, when the receivership was discharged and the company's property ordered turned over to its officers. Then a further dispute arose as to who were the legal officers of the company. The Baker faction, by virtue of the negotiations for settlement, claimed that it was entitled to resume the reins of control, while the Straine-Lamson faction, on the other hand, claimed that it was, because the means employed to give the majority of the directors to the Baker faction were illegal, the New Jersey law, under which the company is organized, not being followed. The result of this dispute was only the restoration of the receivership and the reference of the question of who were the legal officers to a master, who has made his report, but whose report yet remains to be acted upon by the court. The application for the sale of the stock by the receiver was pressed by Moorfield Storey, counsel for the plaintiff. He claimed that this was the best time to sell. If it is held longer, he said, it will become wasted because of several attachments laid upon it in suits brought in New Jersey against Straine. W. M. Stockbridge, counsel for the defendant, Lamson, objected to the stock being sold. He claimed there was no foundation in fact for the reasons urged by counsel for the plaintiff for the sale of the stock. The company is a growing concern and is solvent. The suits in New Jersey cannot affect the right of the company upon the 6,500 shares of stock, because they were pledged to it before those suits were begun, consequently the pledge is valid as against subsequent attachments. R. M. Morse, counsel for the receiver, stated to the court that while the receiver occupied a neutral position with respect to the antagonism existing between the parties to the case, still he felt that this was not a good time to dispose of the stock. If it is sold now only a nominal price will be realized from it. Counsel further stated that the company is doing business now, and is making money. It has an inclusive contract with the Boston Stock Exchange to furnish its quotations to brokers in the city. Judge Colt took the application, as well as a motion made by the defendants for leave to file a demurrer to the plaintiff's bill, into consideration.

One hundred and fifty members and guests of the Massachusetts Street Railway association had an all-day's outing on July 11th, the Quincy & Boston Street Railway company, of which John R. Graham is president, being the host of the day.

The mayor and Board of Aldermen of Concord, N. H., have refused to grant the petition of the Concord Telephone company, a branch of the People's Telephone company of Laconia, for permission to establish an exchange in Concord in opposition to the New England company. The Bell company was represented by counsel before the board, as was also the petitioning company. Some interesting facts were brought out in regard to independent telephone enterprises in the state. Counsel for the petitioners stated that in the county in which Concord was located there were more than 1,000 independent exchanges. In Laconia the company had 234 subscribers, many more than the American or Bell company had. In the first five months the company paid a dividend of 11 per cent. "We can compete with the Bell company and our experience proves it," said counsel for the petitioners. "There is no job and no scheme here. In Laconia we started with a capital of $5,000. In 24 hours recently we raised $7,000, with which we propose to extend our lines to Tilton, Franklin and to Concord. Of the increase, 150 shares at $25 were taken in Franklin because the investment was a paying one. A company of 300 subscribers in Concord can pay a 10 per cent. dividend at $1.50 a month, or $18 a year per instrument. If you can get telephones for $18 for which you are now paying $52, why should you care even if there is a job in it?" The adverse vote on granting the petition was nine to three.

The West End Street Railway company has just filed its returns for legislative expenditures during the last session. It cost the company something over $15,000 to oppose legislation inimical to its interests, the great part of which was spent in opposing the proposed free transfer law. C. S. G.

Canadian Intelligence.

OTTAWA, Ont., July 20.—The Ottawa Electric Street Railway company is making a large addition to it power plant at the Chaudiere. A new electrical generator of 400 horse power capacity is being erected. The armature of the machine was made by the Westinghouse company at Pittsburg, while the fields were wound by Ahearn & Soper of this city. The new machine will be ready for use within a fortnight and will increase the capacity of the electric plant to about 2,200 horse power.

Since the incorporation of the Southern Counties Electric Railway company, which was accomplished in the last days of the recent session of the Dominion Parliament, the promoters of the enterprise have lost no time in getting the preliminary work under way. Engineers have been engaged in making surveys along the

line with a view to certain changes in the route as at first proposed. A. J. Corriveau, the company's president, says that the New York capitalists who are interested in the project are delighted with the prospect of success which they see in the new road, and that active work of construction will not long be delayed.

Alderman Lamb of Toronto is actively agitating for the transmission of electricity from Niagara Falls to Toronto. At present the question of long-distance transmission is still in doubt, and it will probably be some time before Toronto uses any power from Niagara Falls. The Niagara Falls Power company, according to the statement made by that company's electrical director to Alderman Lamb, is now transmitting 1,000 horse power from Niagara Falls to the city of Buffalo, a distance of 26 miles. By the first of January next, it is expected, 10,000 horse power will be transmitted to that city by the company, but until it has had actual experience in transmitting a block of 5,000 or 10,000 horse power and has made complete tests of the losses, etc., no positive information could be given in regard to a proposed transmission over the much greater distance involved in the conveyance of power to Hamilton or Toronto.

It is reported from British Columbia that the Rossland district is about to have the benefit of cheap electric power. The West Kootenay Power & Light company, which was recently organized for the purpose of developing the magnificent water power available at the falls of the Kootenay, 10 miles from Nelson, B. C., has just closed a contract for the hydraulic and electrical machinery to develop 2,000 horse power at once with the ultimate power to be afforded by the river at that point, estimated at from 8,000 to 10,000 horse power. Sir Charles Tupper is at the head of the company. The three-phase system will be used. The initial generating plant will consist of two machines having a capacity of 1,000 horse power each, from which the current will pass through step-up transformers, raising it to 20,000 volts. This high pressure energy will be carried to a sub-station at Rossland, a distance of 30 miles, where it will be reduced to a low pressure and used in connection with the different mining operations.

The Canadian Power company has made a move to begin work on its proposed power canal, which, according to the plans on file in Ottawa, calls for a canal 200 feet wide at the bottom, and about 4,000 feet long, running from the Chippewa Creek to the head of the Dufferin Islands. Men have begun clearing away ground for the canal in about the center of the route. The channel is to be 15 feet deep to the water level, and follows a natural ravine from near the head of the Dufferin Islands to Chippewa Creek. The company expects to develop 40,000 horse power at once, one-fourth of which will be for direct use for mills, while the balance of 30,000 horse power will be developed in electrical form and transmitted. W.

PERSONAL.

John N. Beckley of Rochester, N. Y., who was prominent in street railway enterprises in the East, was in Chicago this week.

R. M. Douglass, general manager of the Schuylkill Valley Traction company of Norristown, Pa., was chosen secretary and treasurer of the company by the board of directors, July 15th, to succeed W. F. Kling of the West End Trust company, who had resigned.

James W. McDonough died suddenly in Chicago on July 20th, at the age of 52. Mr. McDonough was an old electrical man, but his principal claim to distinction was based on his invention of a system of color photography which had attracted wide attention in this country and Europe.

The office force of J. Holt Gates & Co., western agents, at 1323 Marquette building, Chicago, for the Walker, Card and Wagner companies, has been greatly strengthened by recent accessions. George B. Foster, formerly in charge of the arc lighting service at the World's Fair, has associated himself with the firm, and so has George W. Henry, formerly western manager of the Steel Motor company, and F. B. Duncan, who has been connected with the Siemens & Halske and Northern Electric companies. These gentlemen are well known and experienced; their services should be of much value to the firm.

ELECTRIC RAILWAYS.

While rumors are current that suburban railroads will soon be equipped with electric motors, it is said that one of the inducements to the railroad companies to make this change is that travel will be increased by reason of the fact that it is far more pleasant to ride behind an electric motor than a steam locomotive. Many persons are deterred from railroad trips in the summer by the unpleasantness resulting from the cinders and smoke from the engines. According to a Chicago daily newspaper, the number of persons who ride on the elevated electric roads for pleasure in warm weather is much greater than the few pleasure riders on the steam elevated line.

It now appears that the Chicago General Railway company is on good terms with the other street railway companies of the city. It has just been announced that the Chicago General Railway company has secured its lease from the Chicago City Railway company for the use of the latter's tracks in East Twenty-second street from the river to Wabash avenue. In the lease is a clause which binds the Chicago City company to obtain an ordinance for and to build tracks in East Twenty-second street between Indiana avenue and South Park avenue, a distance of three blocks. The Chicago General company is then to be allowed the use of East Twenty-second street for the entire distance from the river to the lake, paying a rental to the Chicago City company therefor. It was announced at the offices of the Chicago General company that in view of obtaining its outlet to Lake Michigan there would be no further present effort to seek a downtown terminal. Lawndale passengers will be able to connect with the north and south lines of the Chicago City company at Wentworth avenue, State street and Wabash avenue, and will also have direct connection with the Illinois Central. The construction department of the West Chicago company is also preparing to build a line to the stockyards in Throop, Main and Laurel streets, for which an ordinance was obtained more than two years ago. As soon as this line is built it is to be leased to the Chicago General company, which will then have a connecting line from Twenty-second street to the stock yards. Both lines, it is said, will be completed and in operation before the end of summer.

TELEGRAPH.

A London correspondent states that a crisis is approaching in the relations of the telegraph operators to the British postoffice. The postmaster-general has found it necessary to warn the service that overtime work must be done or the results will be serious to members of the staff. The operators in the postal service have a powerful trades union, and the country is menaced with a strike which will silence the wires and cause great public inconvenience. This strike, it is said, is distinctly one which can be prevented, but the officials are unconciliatory and may force on a conflict throught lack of flexibility.

TELEPHONE.

The *Chicago Times-Herald* of July 22d said: "Chicago Telephone stock sold yesterday at 200 This is the highest price the shares have touched since 1893, when they sold at 210. The first trades made were at 200. The stock closed at 195. The price which the stock reached seems to be an odd illustration of overlooking a valuable security. It appeared suddenly to occur to those who had the stock for sale that at 200 it is on a six per cent. basis, and just why it should not be as desirable as some other 12 per cent. stocks which sell above 200 is not altogether apparent. For months Chicago Telephone sold around 165. Meantime it not only pays 12 per cent. per annum, but it pays it in monthly installments of one per cent. The company has practically a monopoly of the telephone business in Chicago and Cook county. It has the exclusive right to the use of the Bell patents. There are some little telephone companies operating locally in different parts of Cook county, but their field is extremely limited."

TECHNICAL SCHOOLS.

The Missouri State University conferred the degree of bachelor of science in civil engineering upon A. H. Dunlap, H. H. Lotter, W G. McMeekin, W. A. Miller, E. I. Rogers and T. J. Rodhouse. Geo. R. Staikoff received the degree of bachelor of science in electrical engineering and L H. Burkhart obtained a like degree in mechanical engineering.

MISCELLANEOUS.

The bill passed by the Illinois Legislature, appropriating $45,000 for a state building and exhibit at the Trans-Mississippi exposition was approved by Governor Tanner. By the terms of this law the governor is authorized to appoint a commission, to be known as the Illinois Trans-Mississippi and International Exposition commission, which shall consist of 20 members and shall have general direction of all matters connected with state exhibits. Members of the commission are to serve without compensation, but necessary expenses not exceeding in the aggregate $5,000 will be paid by the state. At the close of its service the commission must make a detailed report to the governor covering all transactions and disbursements. Governor Tanner will appoint the commission within a few weeks.

TRADE NEWS.

The Weber gasoline hoisting engines are especially treated in a catalogue just issued by the Weber Gas & Gasoline Engine company of Kansas City. Testimonials from practical mining men show the value of these engines.

There seems to be no question that the International Correspondence Schools of Scranton, Pa., are doing excellent work. Young men or mechanics who wish to study any branch of engineering or technical work at home will surely make no mistake in sending for circulars of information.

Sargent & Lundy of Chicago have associated themselves with the C & C Electric company of New York, in the capacity of general western sales agents, with offices at No. 13 to 15 Monadnock building. They carry a complete line of C & C apparatus, from which shipments can be made promptly. The C & C company, in addition to its well-known types of bipolar machines, is now manufacturing a full line of multipolar generators for direct connection, or belted, and also a line of multipolar motors of the iron-clad type.

The Erie (Pa.) City Iron Works company has gone into the business of manufacturing electric motors for all purposes, having secured the services of C. J. Sturgeon, formerly vice-president and general manager of the Keystone Electric company of Erie, who will have charge of the new department. It is the intention of the company to make a specialty of the manufacture of reversible motors for use on elevators, cranes, mine and dock hoists, or on any machine where a reversible motor can be used to advantage. With these motors will be furnished a new and improved controlling and reversing apparatus. The Erie City company is also making a special motor and controller adapted to intermittent pumping service, arranged so that the motor will be started and stopped by simply a change of water pressure or by a float placed in a tank. It is also prepared to make estimates on equipping factories and shops of all kinds with electric power, and it will carry in stock a full line of motors for the general trade.

BUSINESS.

The Partridge Carbon company of Sandusky, Ohio, has appointed Schminke & Newman agents for New Orleans, La.

As sales agent for the Wagner electrical apparatus in Michigan, Illinois, Wisconsin, Minnesota, Iowa and the Dakotas, with offices at 1323 and 1324 Marquette building, Chicago, J. Holt Gates will give all information and data desired.

The D. A. Kusel Telephone Manufacturing company, St. Louis, states that trade continues good. It has just closed contracts for an exchange at Breckinridge, Mo., and has orders on hand for a number of other exchanges in different sections of the United States.

The Mount Washington Electric Light & Power company, Mount Washington, Md., has recently increased the capacity of its station by adding a 100 horse power engine built by the Ball Engine company, Erie, Pa., being the third engine of this manufacture now in this station.

The Highland electric soldering paste is meeting with a large sale, and the Electric Appliance company, which is pushing this specialty in the West, states that it promises to displace the well-known soldering sticks and soldering acids, as it has many advantages over these two methods of making a joint. The Electric Appliance company is still sending free samples on application.

"The Midnight Sun" is the striking name adopted for the pamphlet describing the Jandus enclosed arc lamps for all circuits. This is a handsome catalogue, and the mechanism of the lamp is described, while the various types, all of graceful design, are illustrated. The favorable result of an independent test of the Jandus lamp is shown. The catalogue may be had of the Jandus Electric company of Cleveland, and it is well worth having.

The New Era gas and gasoline engines, made by the New Era Iron Works company of Dayton, Ohio, are sold on a year's warranty, being guaranteed during that time to run well and to develop the power for which they are sold. If any defects in material or workmanship develop within one year from date of starting, they will be made good without expense to purchaser, upon notice to the company at Dayton, Ohio. A neat catalogue, sent on application, gives full details of these engines.

The Niles (Ohio) Boiler company was incorporated on July 12th, with R. G. Sykes president, John McVey vice-president, J. H. Orwig general manager, E. A. Gilbert engineer, and T. F. Pendleberry superintendent, for the manufacture of boilers, heaters, oil refineries, together with all kinds of plate, sheet and structural iron work, which will include several specialties. The buildings are almost completed, and machinery, consisting of punches, shears, rolls, etc., is now being placed in position, so the plant will be ready for operation about August 1st. The main building will be fitted with an electric traveling crane and pneumatic riveting plant and the smithing shop with steam hammer.

The Western Electric company of Chicago has just issued a beautiful and complete switch catalogue. The different sized switches are described by numbers, with their capacity in amperes, and all the dimensions of the switches are plainly given in tables, so that it is possible to drill switchboards before the switches are received with the assurance that the switches will fit when they are placed in position. Further than this, a cut and catalogue number of every switch part is given, which facilitates the ordering of small parts at any future time. Special switches are made for 500 volts,

and the Q switches, which represent the quick-break type, are made in all sizes from 25 amperes up. There is also shown in the catalogue the latest design of the round type Ellicott voltmeter switch, the "Y" changing switch, and the switchboard spring-jacks, plugs and cords, all of which are high-grade articles. A copy of this catalogue will be sent upon application.

It is a significant fact that the largest users of storage batteries are those who have given the subject of their manufacture and application the greatest amount of study. Four of the Edison companies equipped with chloride accumulators have contracted for duplicate plants, *i. e.*, New York, Brooklyn, Boston (three installations) and Lawrence, Mass. About a year ago a battery of chloride accumulators was installed in the New York custom house for the purpose of furnishing current for 12 hours per day when the dynamos were shut down. A contract has just been closed by the Electric Storage Battery company for a second plant, to be installed in the New York custom house to be used for maintaining the night lamps in the sub-treasury and the assay office. Other contracts recently closed cover batteries of chloride accumulators for the San Francisco Gas & Electric company, the Criminal Court building, the Commercial Cable building, the Queens Insurance building, New York, the State Mutual Assurance company's new building at Worcester, Mass., and for Smith & Wesson at Springfield, Mass. The installation of two batteries of large capacities has just been completed for the Consolidated Traction company of Pittsburg, where they are used for regulation and maintaining the potential on their trolley lines, and the Barre & Montpelier (Vt.) Railway company has just contracted for a battery for regulation. The Postal Telegraph-cable company is installing chloride accumulators in its offices in Alburquerque, New Mexico, and El Paso, Texas.

ILLUSTRATED ELECTRICAL PATENT RECORD.

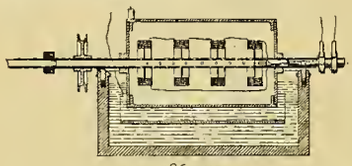
Issued July 13, 1897.

586,133. Method of and Means for Supporting and Insulating Electric Conductors. Harry W. Leonard, East Orange, N. J. Application filed February 13, 1897.

The conductor is attached to the support at intervals through the agency of an adhesive material, the conductor being free to expand without subjecting the adhesive material to injurious strains.

586,171. Process of and Apparatus for Electro-refining Copper or Other Metals. Charles R. Fletcher, Boston, Mass. Application filed January 27, 1892.

The improvement to the art of depositing metals by electrolysis consists in dissolving by an electric current an anode immersed in an electrolytic bath and depositing the metal upon a cathode supported in the bath, and maintaining in the interior of the cathode during such deposition a source of artificial heat, whereby the heat is conducted outward through the metal as it is deposited.



NO. 586,171.

586,193. Transmitting Electrical Signals. Guglielmo Marconi, London, England. Application filed December 7, 1896.

The transmitter is capable of producing electrical oscillations or rays at the will of the operator, and the receiver, located at a distance, has a conductor tuned to respond to such oscillations; there is a variable resistance medium in circuit with the conductor, whose resistance is altered by the received oscillations; means are provided controlled by the received oscillations for restoring the resistance medium to its normal condition after each reception of such oscillations, and means for rendering the received oscillations manifest.

586,208. Electric Arc Lamp. Bernard A. Stowe, Cleveland, Ohio. Application filed December 28, 1896.

A device is so disposed as to intercept rays of light from the arc as they pass from the arc and through the inner globe, indicating on the outer globe the extent of consumption of the carbons.

586,234. Dynamo-electric Machine or Electric Motor. Abraham R. Griebov, Baltimore, Md. Application filed June 2, 1896.

A dynamo or motor comprising the frame, having the field magnets formed thereon, a supplier or collector suitably attached to the frame provided with a series of segments, a commutator and armature suitably mounted on a shaft, the commutator being provided with a series of segments adapted to be held in contact with the series of segments on the collector.

586,236. Process of Electrolytic Decomposition of Solutions. Léon P. Hulin, Modane, France. Application filed July 6, 1894. Patented in France November 25, 1893, and in Belgium November 27, 1893.

The process consists in confining an electrolyte between two permeable electrodes, constituting an anode and a cathode, passing a current through the electrodes and electrolyte and causing the resulting anions to filter through the anode and the cations to filter through the cathodes.

586,275. Incandescent Electric Lamp. Hermann F. Schaedel, Cleveland, Ohio. Application filed July 6, 1896.

This lamp consists of the following parts in combination: A globe having a depression in its neck, the lamp terminal and the metal cap which embraces the neck of the globe, and which serves as or is permanently connected with the other lamp terminal, an insulated contact piece which is secured in the depression, the two carbons contained in the globe, permanent electrical connections between the ends of the carbon and the termical and cap respectively, permanent electrical connections between the ends of the carbon and the termical and insulated piece respectively, and a switch for electrically connecting the cap and piece.

586,282. Raceway for Electrical Conductors. John H. Bleoo, Brooklyn, N. Y. Application filed April 13, 1897.

A raceway for the reception of a bare electric wire has an exposed inner metallic surface, and is capable of being bent; means are provided for insulating the raceway from surrounding objects.

586,285. Switchboard. Charles E. Egan, Chicago, Ill. Application filed May 1, 1897.

A jack is made flexible to permit it to be moved in effecting the electrical contacts, and the drop-magnet is mounted upon and movable with the jack.

586,302. Take-up Device for Trolley Cords. Albert J. Wood, Springfield, Mass. Application filed April 9, 1897.

A spring take-up roller is mounted near the base of the pole, a cord is provided having a winding engagement with the take-up roller, and having at its end a cord-guide with which an intermediate portion of the trolley cord has a running engagement.

586,317. Electric Light Fixture. Louis McCarthy, Boston, Mass. Application filed March 18, 1897.

An intermediate insulating disk is placed between the canopy and ceiling or support, and formed with an annular groove in which the edge of the canopy rests.

586,372. Insulator. Henry W. Steinberg, Jr., Walla Walla, Wash. Application filed December 3, 1896.

This device consists of a block of glass or other insulating material, a screw cast or otherwise secured in the block by means of which the same may be attached to a suitable support, the block being further provided with an irregularly shaped slit in its upper end, in which the line-wire is adapted to fit, and with an opening extending laterally through the block and passing through the slit at a point just above its lower end, and a securing-wire fitting within the opening.

586,378. Adjustable Support for Incandescent Electric Lights. Charles A. Carmany, Ephrata, Pa. Application filed March 22, 1897.

A device is described, comprising the non-conducting base, the parallel standards secured thereto, a non-conducting drum, conducting disks fixed on the outer ends of the drum and journaled in the standards, a transversely divided cylindrical shaft mounted in the drum and having the contiguous ends insulated from each other by a non-conducting disk, a spiral spring having its inner end fixed to one of the standards and its outer end connected to one of the disks, in combination with a duplex flexible conducting tape having the contiguous ends of its conductors electrically connected to the insulated sections of the divided shaft, and adapted to be wound on the drum in the contrary direction to the spiral spring.

586,399. Electric Lamp for Vehicles. Malcolm P. Ryder, Westfield, N J. Application filed September 10, 1896.

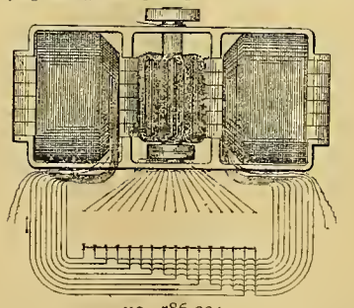
One claim is for a current transmitter, comprising an elastic-limbed brush held in an insulating holder-block by a central screw and a nut held from turning by the flanges of the holder-block, the brush having enforced contact with a current-collector ring forming part of the electric generator.

586,416. Primary Battery for Bicycle Lamps. Thomas F. Boland and Harry C. Hubbell, Elmira, N. Y. Application filed December 24, 1896.

A metallic rod constitutes one terminal of the battery, enlarged at its lower end and embedded in the bottom of the casing and vertically slitted at its upper end, while a protecting covering extends from the bottom of the casing part way upwardly of the height of the rod, and a zinc element provided with a socket or recess at its lower end is adapted to fit over the rod and extend downward to overlap the protecting coating of the rod.

586,422. Electric Railway System. Lawrence K. Devlin, Havre, Mont. Application filed May 24, 1895.

The combination is described of a box having a perforation in its wall, bearing-plates secured to the wall of the box on opposite sides of the perforation and provided with aligned studs, and a lever pivoted between the studs and playing through the opening in the wall of the box.



NO. 586,234.

586,435. Arc Light Holder. Charles A. Haney, Pittsburg, Pa. Application filed February 19, 1897.

Details of construction include a casing on the upright, a sprocket-wheel in the casing, a cross-piece carried by the upright, a hanger carried by the cross-piece, a pulley secured in the hanger, a bracket secured to the cross-piece near the upright, a roller secured to each arm of the bracket, a passage-way formed between the rollers of each arm for the lamp-bracket, an endless chain engaging the sprocket-wheel and pulleys, and a hanger carried by the endless chain to support the lamp and adapted to operate between the rollers.

586,439. Joint-piece for Electrical Conductors. Ellwood Ivins, Philadelphia, Pa. Application filed November 11, 1896.

This joint-piece consists of a seamless tube, having its sides indented so as to form three independent tubes arranged in triangular form.

586,459. Dynamo or Motor. Albert W. Smith, Washington, D. C. Application filed May 3, 1897.

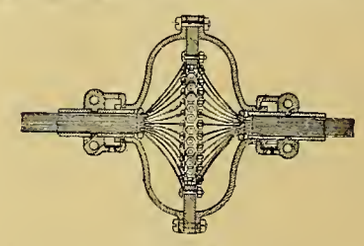
A field magnet has on one side of its neutral gap or point a single wide pole or polar area, and on the other side of the neutral gap or point a coil containing spaces contiguous to the armature.

586,463. Cable Head for Electric Wires. Henry A. Tobey, Toledo, Ohio. Application filed January 14, 1897.

A cable-head is described, comprising shells forming a casement, openings in the casement for the admission of the cables, the openings provided with suitable sealing material, a connection-plate clamped between the shells, and means for hermetically sealing the junction formed by the shells and plate.

586,464. Cable Head for Electric Wires. Henry A. Tobey, Toledo, Ohio. Application filed March 5, 1897.

An annular disk of non-conducting material is secured in and inclosed by the cable-head for affording ready access for change in wire connections; there are also a removable cap for the head, main cable and branch wires entering the head, and connection studs for the wires in the disk.



NO. 586,463.

586,479. Electric Igniter for Gas Engines. Harry S Dosh, Baltimore, Md. Application filed February 17, 1897.

Two electrodes have their ends formed as extended plates, lying sufficiently close together to cause by their separation a rarefraction of the gaseous medium between them.

586,511. Igniter for Explosive Engines. Edward J. Pennington, Racine, Wis. Application filed May 13, 1895.

A rigid electrode and an elastic electrode are employed, the latter with its free end arranged to contact the rigid electrode and be snapped thereby during the movements of the piston.

586,514. Commutator Truing Device. Percy B. Bosworth, Fort Wayne, Ind. Application filed December 17, 1896.

The device comprises a two-part base adapted to be rotatably mounted on the armature shaft secured against longitudinal displacement, a hand-crank fixed in the base at right angles to the plane of the shaft and provided upon its free end with an operating handle, a driving-head vertically adjustable on the crank, laterally apertured for the tool-holder and provided with an internally screw-threaded revoluble sleeve arranged on the same axial line with the lateral aperture, a cylindrical tool-holder mounted in the sleeve and the aperture, arranged in parallel relation with the shaft, carrying a cutting-tool upon its working end, and having in its rear end a rigid screwa dapted for a horizontal feeding engagement with the sleeve, a feed-wheel fixed on the sleeve and adapted for an actuating engagement with a feed-pin arranged in a fixed position relatively to the shaft.

586,516. Electric Telpher Towing System. Harding F. Gray, Passaic, N. J. Application filed February 14, 1894. Renewed October 19, 1896.

When utilized for towing, poles are located outside of the tow-path and braced against lateral and longitudinal strains; there are electric tracks or cables, one mounted upon the braces and another upon the poles, a motor running upon the tracks, and means for connecting the motor to a canalboat.

586,529. Telephone System. William W. Davis, St. Louis, Mo. Application filed September 5, 1896.

Included in the arrangement are a bell-ringing circuit, the secondary circuit and the receiver-hook for closing the secondary circuit, a foot switch normally closing the bell-ringing circuit, and spring-contacts with which the foot-switch is adapted to make contact, the contacts being terminals of the transmitter primary circuit, whereby, when the foot-switch is depressed, it cuts out the bell-ringing circuit and cuts in the transmitter primary circuit.

586,537. Electric Gas Lighter. Frank Rhind, Bridgeport, Conn. Application filed May 17, 1897.

Features of this device are a stationary electric terminal, a gas-cock, an operating lever on the cock, a button pivotally attached at or near the end of the lever, a wire contact-arm formed with a spring-coil secured to the button, a handle or pendant connected with the button and the lever, and adapted to operate the cock through the lever and to rotate the button on the lever, so that the contact-arm may be brought into contact with the stationary terminal during the opening of the cock and be carried back through a different path, so as to avoid contact with the terminal during the closing of the cock, and a spring pivotally attached to the lever and adapted to hold the cock either in its closed or open position.

Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, JULY 31, 1897. No. 5

The Suburban Railroad Company's System.

Probably there is no electric railway in or about Chicago which is operated on conditions so nearly approximating those that usually obtain in steam railroad service as that of the Suburban Railroad company. This company operates a system of lines just west of Chicago, connecting one terminus of the Metropolitan elevated railroad with the Harlem race track, Central Grove, Austin, Oak Park, River Forest, Concordia, Forest Home and Waldheim cemeteries, Riverside, Grossdale and La Grange. Some of its lines are leased from the Chicago & Northern Pacific and Wisconsin Central Railroad companies, and were formerly used for steam railroad service; others are newly built; but all are of standard gauge, with heavy rails and well ballasted track construction. The work of electrically equipping the old and building the new lines, erecting the power house and car barn and furnishing the machinery and rolling stock was and is being carried out by Naugle, Holcomb & Co. of Chicago, who are also operating the road, and will continue to do so for a period of two years. Part of the lines of the system are laid in streets and the remainder through private rights-of-way. It is the intention to connect with one of the elevated railroads by inclines, and thus run the coaches of the Suburban company down town and around the Union Loop.

About 14 miles of line is now in operation. The road is cinder ballasted, and the ties are cedar on tangents and oak on curves. Servis tie plates and Chicago rail bonds are used throughout. Seventy-pound seven-inch rail is used in the streets, and a lighter rail on the other portions of the road. The overhead system of electrical transmission is used, and the construction is heavy and substantial. The feeders are of 500,000 and 350,000 circular mils area, and No. 00 trolley wire is used, suspended from span wires in the usual manner. The wire was furnished by the Washburn & Moen Manufacturing company. The height of the trolley wire above the rail grade is 22 feet 6 inches.

The cars are from the Pullman shops and are handsome and comfortable. They are 40 feet 6 inches long, shorter than the standard coaches of steam railroads, but considerably longer than the ordinary electric street car. They have rattan cross seats and center aisles and seat 48 passengers each. The motor cars have vestibules at each end, two McGuire trucks and two 18 foot trolley poles. Upon each truck is mounted a 50 horse power Walker motor, and there are two Walker controllers on each motor car. Christensen air brakes are used, the compressor being driven from the car axles, except in the case of one car, in which a separate electric motor is used for this purpose. Hand brakes are also provided. The cars are so constructed that they are comfortable for service all the year round, being adapted to be closed in winter and practically open in summer. An excellent feature is a system of push-button calls, by which a passenger can, without leaving his seat, signal the conductor to stop the car by simply pushing a button. The Gold hot-water heating system is used for the cars. Each motor car weighs 22 tons and each trailer 13 tons. A train consisting of a motor car and trailer is shown in Fig. 1 (p. 58).

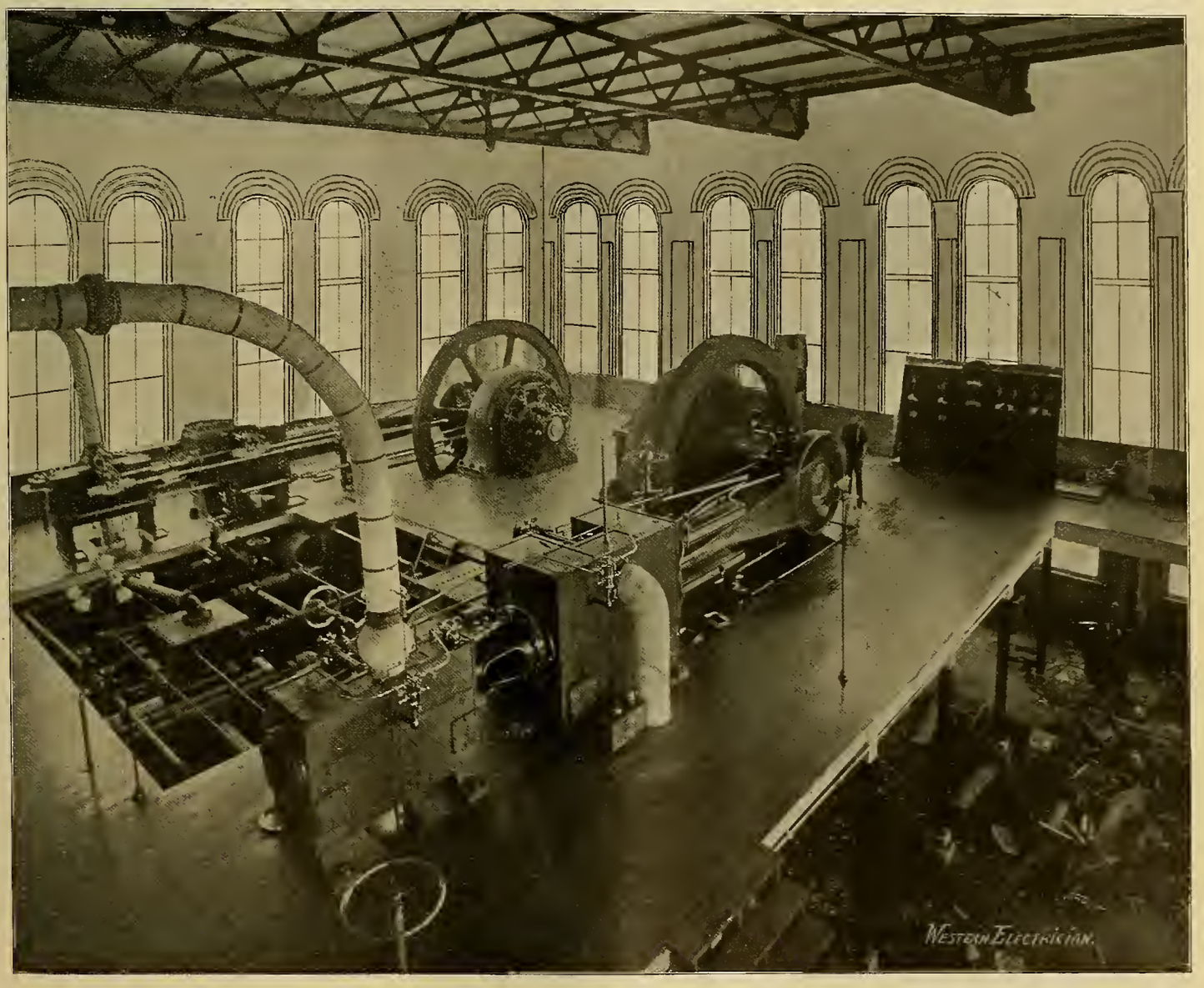


FIG. 4. THE SUBURBAN RAILROAD COMPANY'S SYSTEM — ENGINE AND DYNAMO PLANT.

The power for operating this system is obtained from a power station located on the northwest corner of Harlem avenue and Twenty-second street, which is about the center of the system. The power station building (Fig. 2) is of brick, 108 by 96 feet and 42 feet high. It is divided into two rooms by

a division wall, which extends through the roof, making a fire wall. The general arrangement will be easily understood by referring to the sectional drawing, Fig 3. In the larger or engine room there is provision for the installation of a traveling crane, and everything has been done to make the plant a modern and economical one. A general view of the engine room, taken from an elevation, is given in Fig. 4. Here are installed two direct-connected units, and provision has been made for the installation of two additional units of 400 kilowatts each. The present installation consists of two tandem compound improved Green engines, manufactured by the Providence Steam Engine company, Providence, R. I., one being a 12 by 22 inch with 48 inch stroke, and one 17½ by 33 inch with 48 inch stroke. These engines are provided with flywheels 16 feet in diameter and weighing 30,000 pounds and 50,000 pounds respectively, and will develop, when operating at their greatest economy, under a steam pressure of 125 pounds per square inch above atmosphere, with cut-off at one-quarter stroke and running at 100 revolutions per minute, 240 indicated horse power and 560 indicated horse power respectively, and are capable of reaching a 50 per cent. overload continuously without straining. The jet condensers used in connection with the engines are of the independent Deane type and were furnished by the Deane Steam Pump company.

Current is generated at a pressure of 650 volts by two multipolar Walker railway generators of 250 kilowatts and 400 kilowatts capacity, which are direct-connected to the smaller and larger engines respectively, and which were manufactured by the Walker company, Cleveland O. The switchboard, which was also furnished by the Walker company, is of black enameled slate, with illuminated dial instruments, Cutler-Hammer circuit breakers, and is made up in five panels, as follows: One main panel on which total station readings are taken, two machine panels and two feeder panels. Each feeder panel has provision for two feeder circuit connections.

In the boiler room the installation consists of three Stirling water-tube boilers of 250 horse power capacity each, furnished by the Stirling Boiler company, Chicago, and equipped with Brown mechanical cleaners. There are two boilers in one battery and one boiler is set singly. The latter is arranged so that an additional boiler can be installed at any time, making a battery of two. The battery is equipped with Meissner mechanical stokers, manufactured by the Meissner Engineering company, Chicago, while the single boiler is equipped with flat grates. The gases are led from the boilers through a breeching built up of plate steel and lined with fire brick and tile to a self-supporting steel stack, both of which were furnished and erected by the Stirling Boiler company. The stack rises from a brick stub or base 22 feet in height above inside grade, which is octagonal in shape, being 20 feet across and resting upon a concrete foundation 26 feet square. The steel portion of the stack is 125 feet in height, is lined one-half the height with fire brick and has a flue 96 inches in diameter. The total height of the stack is 147 feet. Coal screenings are used for fuel.

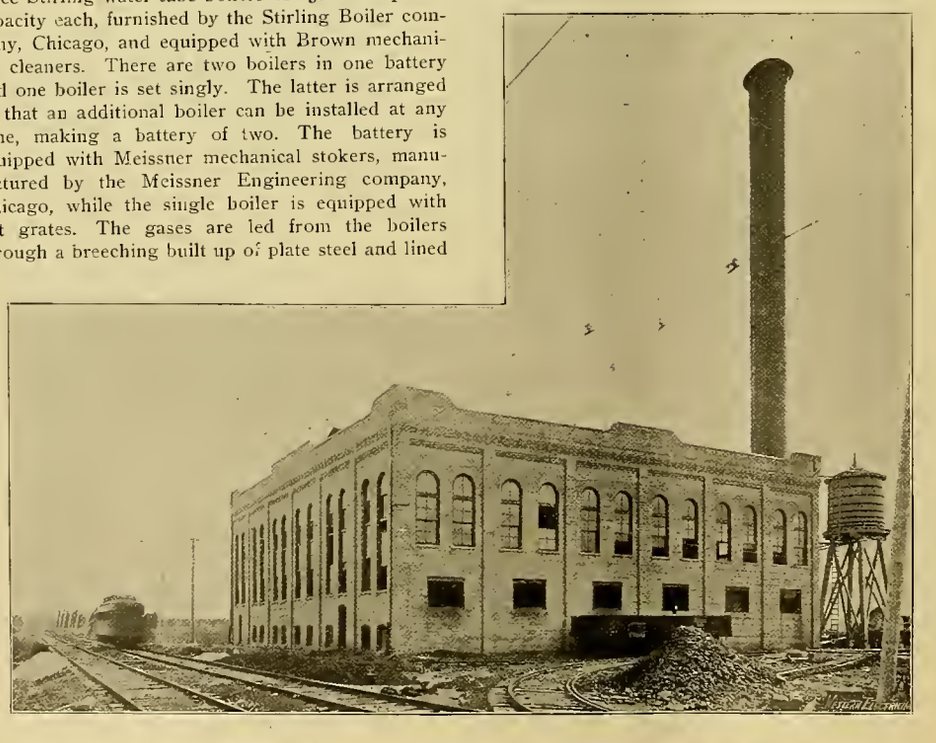


FIG. 2. THE SUBURBAN RAILROAD COMPANY'S SYSTEM.—THE POWER HOUSE.

The water for the operation of the plant is obtained from an eight inch drilled well 190 feet deep by means of an air lift. The compressed air is obtained by the use of an Ingersoll-Sergeant air compressor, driven by an Ahlm-Edwards multipolar motor of 10 horse power capacity. The water from this well is either delivered into a wooden tank (Fig. 2) at an elevation of 28 feet above grade, from which a five-inch main leads into the station and supplies water for circulation in the main pillow blocks of the engines, priming for condensers and general purposes, or is delivered into a cooling and storage reservoir 105 by 205 feet in dimensions, which has a depth of water of seven feet. This reservoir, shown in Fig. 5 (p. 60), was constructed in the manner indicated by the drawing, Fig. 6. From this reservoir the water enters the station through the crib, shown in Fig. 5, and an 18 inch main. This main supplies the water for condensing purposes, and a connection is also made so that water can be pumped for fire purposes. After the water has passed through the condensers it is discharged into an 18 inch main which leads back to the reservoir but empties upon a system of cooling tables, as shown in Fig. 5. These are constructed of wood and consist of three leaves 182 feet long and 30 feet wide, making a travel for the water while exposed to the atmosphere of 546 feet before it is precipitated into the main body. After entering the main body the water is obliged to travel 220 feet before entering the supply main. In this way a reduction of from 20 degrees to 30 degrees in temperature is gained. The water for boiler purposes is pumped from the overflow main, which gives a temperature of about 90 degrees to 100 degrees. From here the water is put through a system of feed-water heaters and purifiers. These heaters and purifiers consist of two Cochrane pre-heaters, one placed in the exhaust line from each engine, between the engine and condenser, and one Cochrane heater and purifier furnished by the Harrison Safety Boiler company, Philadelphia, from which the water is taken at a temperature of 208 degrees to 212 degrees and pumped into the boilers by an M. F. Davidson outside packed plunger pump. The water is pumped from the overflow main and forced into the heaters by a Laidlaw-Dunn-Gordon pump, which also performs the duty of a fire pump.

The piping system is in every way complete and

FIG. 1. THE SUBURBAN RAILROAD COMPANY'S SYSTEM.—MOTOR CAR AND TRAILER.

is so designed that each individual piece of apparatus can be cut out without affecting any of the other pieces. All piping which is under steam pressure is extra heavy wrought-iron with screwed and pened flanges, is put together with steel bolts and Rainbow gaskets, and Crane valves are used throughout. The main header is 16 inches in diameter and is connected to the boilers by U-shaped bends. Besides the main header there is an auxiliary header 10 inches in diameter, and there is also a five-inch header from which the steam supply is taken for operating the pumps and condensers. The steam connections between header and engines are equipped with Cochrane separators, thus avoiding all danger of water getting into the engine cylinders. Inserted in the exhaust lines from engines and between the engines and pre-heaters are Cochrane oil separators, which remove the oil from the exhaust steam, thus avoiding the collection of oil on the surface of the reservoir or of carrying any into the boilers. The piping system for the water supply is so arranged that any individual piece of feed-water heating and purifying apparatus can be used independently, or all can be cut out and water supplied direct to boilers from either overflow from condensers or from reservoir by means of the pumps. There is also a five-inch pressure main throughout the station from which water can be taken in case of fire. In addition there is a six-inch water main running to the car house for fire protection, as well as 2½ inch main for general uses. The water in the 2½ inch main is supplied from the wooden tank and is pure water, while that in the six-inch main comes from the reservoir and is for washing cars and fire protection only.

Situated 422 feet north of the power station on Harlem avenue, and with its longer dimension parallel to the street, is the car house, which is a brick building 224 by 114 feet and 22 feet in height. This building is open and has a system of ladder tracks at each end, thus making is possible to run cars in or out of the building from either end and removing all special work from the main tracks. All the tracks inside the building pitch from the center toward each end, with a grade of about one-half of one per cent., thus making it very easy to remove cars in case of fire, the only requirement being to open the doors and release the brakes. Adequate provision for cleaning the cars has been made, and there is a wash rack with concrete floor, having a capacity of four cars. Provision has also been made for the rapid repair of brakes or small portions of the car apparatus in a pit with standing room for two cars under one main track, thus enabling the car to enter at one end, receive its repairs and proceed on its run by passing through the building. Located along the west side of the building is the storeroom, armature department, blacksmith shop and machine shop.

These departments are equipped with every facility which is necessary to the rapid repair of either motors, trucks or air brakes. The pit in the machine shop has a capacity of two cars and is equipped with a hydraulic jack car, which can be used at any point in the pit. There is also a hand-power crane for lifting machines from the pit to the main floor of the shop.

In the earlier stages the engineering work of this railroad system was in charge of B. J. Arnold, but when the enterprise was given to Naugle, Holcolmb & Co. this work was done under the supervision of George Weston, manager of the construction department of that firm, and of W. H. Holcomb, Jr., his assistant. Other engineers who should be mentioned are I. B. Walker, electrical and overhead work; C. E. Thomas, track construction, and Charles A. Chapman, mechanical engineer, who designed and built the power house and car shed. The operation of the power-house plant is in charge of J. S. Barringer.

Utilization of Exhaust Steam.[1]

By George L. Thaver.

In the lowering of prices of modern industrial enterprises comes the important question of the utilization of the by-products. In some lines manufacturers may be said to make their entire profits from the wastes of a few years ago. You are all familiar with the by-products in gas manufacture, sulphate of ammonia, the analine dyes and others. The large packing houses find a great profit in what the local butcher throws away. In four-fifths of the electric light stations we are wasting a by-product of greater relative value than any other industrial concern. The exhaust steam carries away 85 per cent. of the heat supplied by the boilers. The problem confronting the station manager of the day is this: Can this stream of energy now being wasted be put to some use, and, if so, will it pay to do it?

This question can hardly be answered off-hand, but I wish to say that generally speaking there is no extension of your business that will pay larger profits on the investment than that of steam heating.

The pioneer in central station heating is the American District Steam company of Lockport, N. Y., using the Holly system. That company was installing plants as early as 1885, using live steam. Commercially the plants were not successful. The installations were what are known as the "gravity system," that is, the movement of the condensed water is controlled by the pitch of the piping. The special fittings of the steam mains are numerous and well designed, the object being to obtain a line of pipe in which the expansion is taken care of, and repairs reduced to a minimum. The condensed water from the radiators is not returned to the station, but led into a special radiator, where the remaining available heat is extracted and the water allowed to go to waste.

It was found in the operation of any extensive heating plant that it was very difficult to force steam to the farthest points of the system, even when the piping was carefully designed, without undue back pressure on the engines. Unless the air was removed from the interior of the radiators, the full value of the heating service could not be utilized. When the steam pressure was only a fraction of a pound, the air valves did not readily remove the air. The circulation could only be improved by going to great expense for enlarged mains.

The first attempt to obviate this difficulty was to put a return valve in the radiators and pump the air and condensed water back to the boiler. In order that one radiator should not short-circuit the entire system, the valves were only partially opened. The engineer used his own judgment as to their adjustment.

In practical operation the method had some drawbacks. The circulation was greatly improved, but the adjustment of valves that was found to be best for mild was not suitable for cold weather. They required constant attention for this reason. Besides the correct opening for the valve was at best a guess on the part of the engineer; if not enough the radiator did not get thoroughly hot, and if too much the suction in the return was interfered with and the surplus steam had to be removed by a condensing coil. This was the original vacuum apparatus, the so-called "Williams system."

Since then two rival concerns have obtained patents on improvements and on details. The situation reminds one a little of the incandescent lamp patents five or six years ago. The real improvement was the substitution for the set valve of the Williams system of an automatic valve which closed as soon as the steam reached it. The valve is only a modification of the automatic air valve on radiators, with which you are all familiar. This valve operates by the difference in expansion between a cylinder of some rubber compound and the metallic body of the valve.

One of these concerns places the valve at the bottom of the radiator and draws both the air and the condensed water through it. It is then pumped into a receiving tank at the boilers, where the air is allowed to escape. The pump exhausts into the general heating system. Because of the forced circulation the returns are about half the size for an ordinary gravity job. The service pipes, it is claimed, can also be reduced somewhat in size. The other system is usually designed for the use of one pipe, that is, the radiator has only one valve for both steam and water. The automatic air valve is placed as usual and connected with a system of return pipes. The air is removed, the condensed water returning to the boiler or receiving tank by gravity, through regular returns. Instead of using a pump the suction is maintained by means of an injector.

As is apparent, the weak point, if any, is in the thermostatic valve. This the makers claim is thoroughly reliable and gives no trouble in operation. It should be remembered that a failure of the valve is a failure of the entire system. The cost of maintaining the vacuum is also an objection, though not serious.

As to operation, there is no doubt that the circulation is practically perfect, the extreme radiators being heated with ease in the coldest weather, and steam being circulated at practically atmospheric pressure. With a plain gravity system, no matter how well installed, it is necessary at times to carry five to eight pounds back pressure on the engines. This cuts down the capacity of the engines much more than a corresponding loss of boiler pressure would. An inspection of an indicator card will make this plain. If on the card a line be drawn representing five pounds back pressure and a line representing five pounds less than admission pressure, it will be apparent that the area of the card is changed more by the lower line than by the upper. This back pressure also operates unfavorably against the best results with engines which expand down to nearly atmospheric pressure, as compounds and underloaded Corliss engines. It may seem strange, but it is an actual fact that a gravity plant can be changed into a vacuum system and the coal consumption reduced considerably, and that, too, with better results in heating.

When the boiler feed water is of a bad quality it will pay to return the water of condensation. Where a good grade of cylinder oil is used there will be no difficulty with the very small amount of oil coming from the heating system. There will be enough fresh feed-water added to prevent any trouble which would come from using distilled water in the boilers. It is needless to say that corrosion and scaling, with their attendant expense, will be largely reduced. However, the loss through wasting the condensed water is not as great as may seem at first. The condensation can be led into an indirect radiator and used to heat the fresh air from outside. The water leaving the coil will have all available heat removed. If, on the other hand, the condensation at 212 degrees be returned to the boiler, the radiation loss in the returns may be more than the heat wasted when the water is discharged from the system.

The correct design and construction of the underground mains is a vital point, if the system is to be successful. It is necessary to secure three results. The radiation losses must be small; unless the distance run is excessive, they should fall within five per cent. of the total system supplied. Expansion and contraction should be provided for. Assuming a range in temperature from 50 degrees to 212 degrees, 100 feet of main will expand 1⅝ inches. In a long line of pipe this becomes a serious matter. The mains should be protected from surface water, as the pipes are soon corroded through when the pipe covering becomes damp. One standard method of construction is as follows: At the bottom of the trench is laid a tile drain. Pine logs are bored and the outside surface painted with asphaltum. These are tenoned together, and the iron pipe, having received its covering, is placed inside. Expansion is provided for by a special fitting, having a flexible diaphragm, doing away with a stuffing box. Service connections are made every 50 feet. The work is simplified by there being no return pipe.

Another method which seems to be successful is to build a box of tarred boards. The pipes are supported a few inches above the bottom of the box to protect them from water which may accumulate at the bottom. The box is filled with asbestos wool, or each pipe is covered with common pipe covering. Expansion is provided for either by expansion joints, placed in manholes, or where the pipe is small by U-shaped offset loops. Whatever method is followed, it pays in the long run to have the work well done.

I am indebted to Prof. R. C. Carpenter of Cornell University for the following data on condensation in steam pipes: The university buildings are heated from one boiler plant, through underground mains. The pipes are laid in a solid log bored two inches larger than the pipe. The thickness of the wood remaining is four inches. The logs were painted on the outside with coal tar and sawdust. There is in the system 150 feet of 10 inch pipe and 2,050 feet of six inch pipe, having a total heating surface of 5,605 square feet. The temperature difference was 235 degrees. Twenty-seven horse power of return steam was required to supply condensation, that is, one horse power loss for each 820 feet of six inch pipe, or its equivalent surface, one horse power being taken as 30 pounds steam at

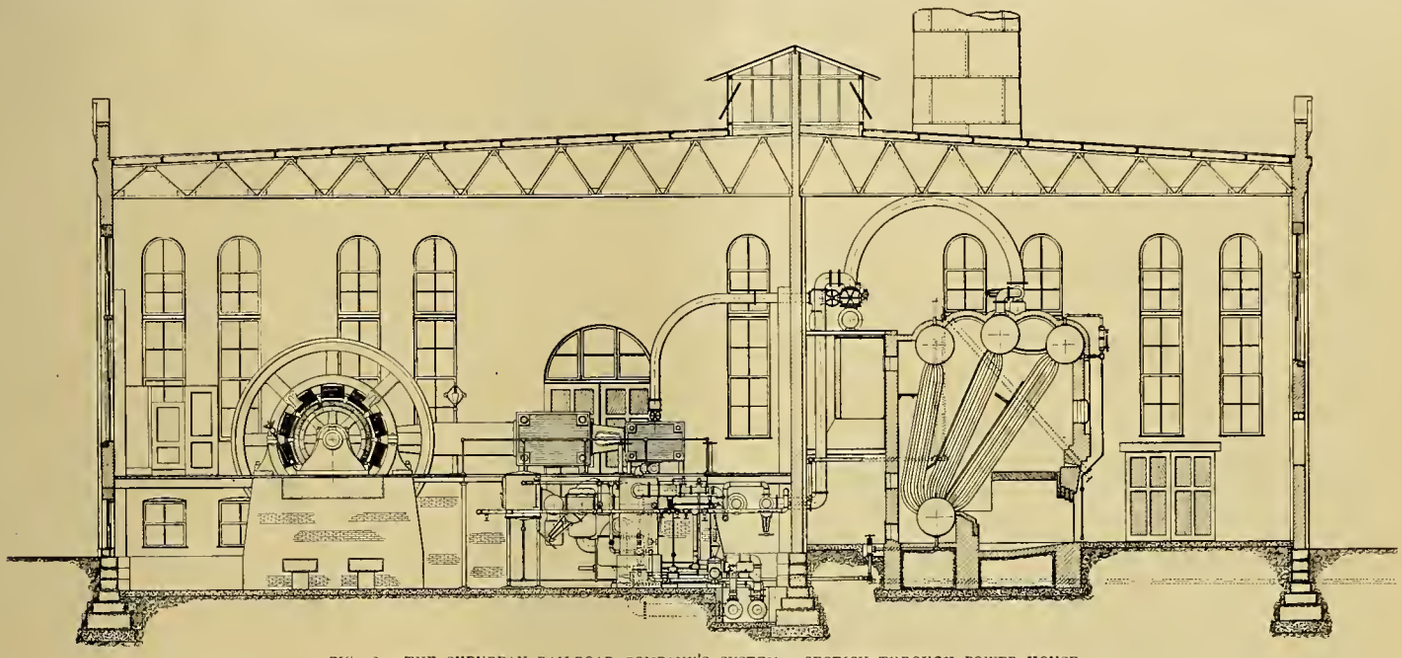


FIG. 3. THE SUBURBAN RAILROAD COMPANY'S SYSTEM.—SECTION THROUGH POWER HOUSE.

1. Read before the Northwestern Electrical association, La Crosse, Wis., July 21, 1897.

70 pounds pressure with feed-water at 100 degrees. In a more technical form the heat loss was .614 British thermal units per square foot for each degree difference in temperature. With what is considered good practice at the present time the radiator losses can be reduced to 40 per cent. of these figures.

There is no hard and fast rule for the proportioning of radiating surface. Of two buildings of the same construction apparently, one will be warm and the other cold.

The number of leaks, the exposure, and a host of smaller items, will make the best of rules more or less in error of radiating surface. The old plan was to allow one square foot of radiating surface to a certain number of cubic feet of contents. A northwest corner room would take about 1 to 30, the great run of rooms, 40 to 60, and large rooms 1 to 100. Stairways and halls were simply guessed at. If a room was hard to warm the fault was laid at some other door than the lack of sufficient heating surface. In private residence work the general circulation of air from room to room evened things up. It was simply pretty good guesswork.

The formulæ given in text-books are quite complex and involve considerable labor. Contractors who do figure by exposures use simpler, though less accurate, formulæ, making such modifications in particular cases as their experience suggests. The method used by a firm in the West, which gave good results with a minimum of work, is as follows: The glass surface was figured first, taking total opening of window frame to allow for leakage. The exposed walls were figured and reduced to equivalent window surface. For unfurred brick or stone walls 15 inches thick, four square feet was taken as the equivalent of one square foot of glass. For ordinary wooden dwellings and furred brick walls the ratio was 1 to 6; extra warm construction was 1 to 8. For Northern Illinois the required heating surface was one square foot for two square feet of glass. In rooms exposed to northwest winds the radiator surface was increased 10 to 15 per cent. Any unusual conditions were allowed for, as experience suggested. The radiator was proportioned to maintain 70 per cent. inside with zero weather outside.

The rates and methods of charging for central station heating vary considerably. There is a tendency to charge according to the space to be warmed, rather than by the square feet of radiation. For a store 20 by 80 by 14 the charge for heating is about $60. The radiating surface required is in the neighborhood of 250 square feet, or 25 cents per square foot heating surface per year. Such a store will use five to seven tons of hard coal in an ordinary winter. At $7.50 per ton it will cost $45 to $50 per year for heating.

You are selling heat practically in competition with hard coal, and the rates you are able to secure will be based on that method of heating. In the territory covered by this association you ought to get from 10 per cent. to 20 per cent. more than the cost with hard coal. You can offer a much better manner of heating, but with the disadvantage of the cost of the radiators and piping. The following are some examples of rates:

Plant 1.—Storeroom, 20 by 90 to 100, $60 to $70; office, 15 by 20, or 20 by 20, $20 to $25; bank, 20 by 30, or 20 by 50, $40 to $50.

Plant 2.—Store, 22 by 60, $50; 22 by 75, $62.50.

Plant 3.—$15 per 100 feet per year or $2 per 1,000 cubic feet in brick stores; $3.50 per 1,000 cubic feet in dwellings.

Plant 4.—$100 to $125 for 10 room house.

Plant 5.—$0.25 per square foot per year.

Plant 6.—$3.50 per 1,000 cubic feet. Heating done by live steam on meter.

As yet there is no meter on the market, except that of the American District Steam company, which is used only on that company's plants, but there is no reason why a reliable meter should not be placed on the general market as soon as there is a demand for it.

The cost of operation, outside of interest and depreciation charges, will naturally vary greatly in different plants. It should be borne in mind that your profit lies in selling exhaust steam rather than live steam. An increase in business beyond a certain point may not pay if fuel is high and the heating rates are low.

One foot of radiating surface will condense one-third pound of steam per hour. Assuming that 5½ months' steady heating will be the equivalent work

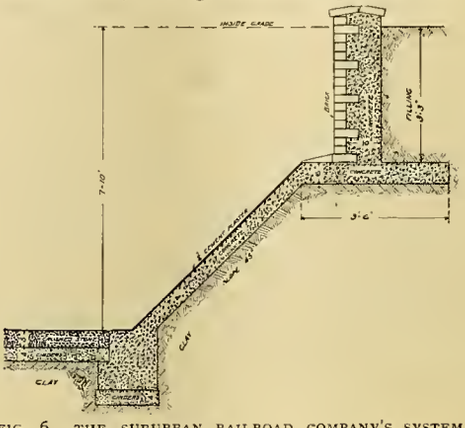


FIG. 6. THE SUBURBAN RAILROAD COMPANY'S SYSTEM. —DETAIL OF RESERVOIR CONSTRUCTION.

for one season, coal at $2 per ton of an evaporation power of seven pounds, the fuel cost will be 19 cents. If the revenue from one foot will be 25 cents, it will probably be found that the business does not yield any profit. In the stations of towns of less than 15,000 inhabitants 75 per cent. of the maximum evening load will be carried for five hours during the heating season. Outside of these hours the load will run about 30 per cent. for the remainder of the lighting hours. The day power load, if any, will hardly exceed the all-night load. The conditions will be that the first floor 30 per cent. of heating business can be done with exhaust steam for at least 14 hours per day. The fuel cost of live steam furnished will be 11 cents per square foot. Another 45 per cent. can be supplied with exhaust steam five hours per day at a fuel cost of 15 cents per season. This would indicate that the profitable heating is that which can be taken care of during the greater part of the evening load. Cost of fuel will determine in each case whether new business will pay on a live steam basis.

Some modifications of central station design will follow when steam heating is added. The boiler portion of the plant becomes of much greater importance. Wastes which otherwise would be small assume greater importance when the work done by the boilers is more than doubled. Every effort should be made to bring them up to the highest efficiency. The installation of auxiliary devices will sometimes be advisable.

It is evident that the value of a condenser is lessened to a plant, for its use will be confined to the summer months. As so many stations have

[*Continued on page 66.*]

FIG. 5. THE SUBURBAN RAILROAD COMPANY'S SYSTEM.—COOLING RESERVOIR AND WATER TABLE.

Extension of Niagara Falls Power Company's Plant.

By Orrin E. Dunlap.

Rapid headway has been made in the work of extending the wheel-pit of the Niagara Falls Power company at Niagara Falls, so that now the work of excavating has been completed, and the pit is ready for arching and bricking. The contractors on this portion of the work were E. D. Smith & Co. of Philadelphia. The steel framework of the power house extension has also been placed, and R. D. Young & Co. are at work on the masonry. The illustration accompanying this article shows the length and size of the extended power house with the structural steel in place. As extended, the power house provides for 10 generators, while the extended wheel-pit has room for the same number of turbines. There are now three generators and turbines in place. Five of these seven additional turbines and generators will be installed at once, the contracts for them having already been made. The Westinghouse Electric and Manufacturing company will build the generators, while the I. P. Morris company of Philadelphia will make the turbines. These concerns made the turbines and generators of the original installation now in use. The new turbines and generators will be of the same capacity as those installed. The new section of the pit will be bricked to a height of about 40 feet with a 30 inch wall, the brick to be furnished by Brush Brothers of Buffalo. In all about 1,500,000 brick will be used. The length of the original section of the power house is 140 feet, while that of the addition will be 286 feet, making a total length of 426 feet.

Several changes of importance have been made in the construction of the new section of the wheel-pit, all of which have been dictated by the experience with the first pit. The depth of the pit is 179 feet, the average width being 20 feet, which is increased at the top to make room for masonry walls six feet wide. These walls are carried down to solid rock, the width between them being 21 feet. In this new section of the pit all the penstock mouthpieces are built in the wall, whereas in the first section of the pit they were inserted after the wall was erected. Under this arrangement, when the new dynamos are installed, no masonry will be necessary, it having already been completed. In the old pit the girders are built right into the wall, but in the new pit they will be supported on castings built in the wall of the pit. Still another change is that to be made in supporting the turbines. The turbines now in place are supported on girders, but in the new installation the wheel case and lower penstock elbows will have projecting ribs supporting them on castings which will be bricked into the walls.

All who have seen or read of the present installation will recall that current for exciting the fields of the generators is obtained from 200 kilowatt rotary transformers, which stand at one end of the switchboard structure. In the new installation a change is to be made in this service, in that four small turbines will be placed in the wheel-pit to operate a like number of exciters, which will stand on the power house floor. Although the present method has been found serviceable, it is thought that the change contemplated will be in the line of an improvement, inasmuch as it will give an entirely independent source of supply for the exciters. It may be stated that the changes made in the supports of the turbines were suggested by Dr. Coleman Sellers, who is chief engineer of the Niagara Falls Power company.

On the west side of the power house addition a new conduit has been built for light and power cables. This is seven feet six inches by four feet four inches. The main subway will be extended to the necessary length.

When the tunnel and first section of the wheel-pit were built the excavated material or "muck" was used for filling in and reclaiming land under water in the upper Niagara, but the "muck" from the wheel-pit extension has been used for filling beneath the trestle of the Niagara Junction railway, which is owned by one of the allied companies of the Niagara Falls Power company and is on the latter company's property. In this way the roadbed was made more substantial. All the work is

done under the supervision of W. A. Brackenridge, resident engineer of the Cataract Construction company. Mr. Brackenridge was connected with the original installation and is familiar with the most minute detail of the work. So far all the contractors have made rapid progress, and the new installation will probably be completed the latter part of this year or the first of next.

James W. McDonough.

By E. E. F.

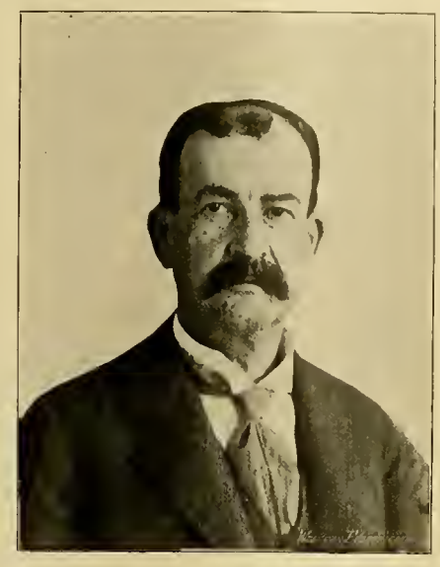
James W. McDonough, whose sudden death in Chicago on July 20th caused much surprise and sorrow to his friends and acquaintances, was a man of exceptional ability, and the loss to the scientific world occasioned by his death will be sincerely regretted. His researches covered many branches—mechanical, electrical and chemical—and, although quietly made, were of great importance, and many of his discoveries and inventions are being used all over the country. Personally, he was a genial, even-tempered man, esteemed by all who knew him. His firm determination and keen perception were almost sure to make his first impressions of any subject correct ones, and on such impressions were founded many of his most successful projects. His generosity will be remembered by many. He never refused to assist a worthy cause, and his advice was of great assistance to all who asked it.

Mr. McDonough was born in St. Louis, Mo., May 5, 1845, and came to Chicago in 1863 or the year after, and in the latter city the greater part of his early business career was spent. Prior to 1878 he was engaged in the furniture business, but during that time he was experimenting on an electrical instrument to transmit music and speech, practically the telephone of to-day. As early as 1867 he constructed an instrument for the purpose of converting an interrupted current of electricity into continuous sound. The instrument was practically the microphone and receiver of to-day—a file, a nail, a box with a paper head, having a piece of iron glued on the center of it and in close proximity to an electro-magnet, all included in an electrical circuit. The result was that upon drawing the nail over the surface of the file a continuous sound was heard in the receiver, practically the same as is heard in a Bell receiver when someone attempts to ring the magneto when the listener has the instrument at his ear.

The deceased inventor was one of the original telephone litigants, and contested with Bell for the honor and profit of the great invention. The finding of the examiner of the United States Patent Office was as follows (as copied from the court records): "Taking, therefore, May, 1875, as the date of McDonough's invention, it remains to be considered whether Bell has proved prior conception, for he does not pretend to have constructed such a receiver prior to July, 1875. Upon this evidence it is impossible to find that Bell conceived, much less disclosed, his invention to Blake in October, 1874. Upon this count, as defined and explained, McDonough is awarded priority of invention."

The fruits of Mr. McDonough's early labors in the telephone field were lost from sickness and from the further fact that the men interested with him did not realize the importance of his work. He went to New York city in 1881 and was electrician for the United States Telephone company and also for the Schuyler Electric Light company. His experiments during that time were on the line of Tesla's more recent investigations—that of producing light from exhausted tubes and tubes filled with finely divided carbon dust by induction from a rapidly reversed electric current of high tension. He also conducted some exhaustive experiments in multiple telephony, by which a dozen or more telephones were operated over the same wire at the same time, the vibrations of the different instruments being synchronized. His success in this work was very encouraging, but his experiments in this line were discontinued on account of more important ones on his recent work of photographing in color. To this work he gave his last and best efforts and all his time for the last three years.

For years previous to this, from a time dating back in the '70's, he had planned and devised methods of photographing in color, all to be abandoned for his latest and more practical method, which at the time of his death had reached a perfected state whereby the world will soon see it in a commercial way. The day preceding his death was spent among the flowers of a beautiful park. Under the influence of a clear atmosphere and bright sunshine the blossoms seemed to give forth their most brilliant hues and delicious perfumes for the crowning effort of his life, and the last picture made was



JAMES W. M'DONOUGH.

of himself seated among them, with the green trees and bright blue sky as a fitting background.

The principle of his process is very simple. He selected three primary colors of the spectrum, red, green and blue. These colors were of such a degree of density that their combination (viewed as colored lights) would produce white light. These colors were ruled upon a transparent medium, such as glass, in very fine lines from 300 to 600 to the inch, or finer. This medium or screen, as it is then called, appears to the unaided eye as a grayish-colored piece of glass. To produce a picture this screen is placed in the camera, color side in contact with the sensitive plate, this sensitive plate being orthochromatic, that is, color accepting. The actual colors are not imprinted on the film, but their values, being accepted, are evenly distributed all over the plate. The exposure being now made, as ordinarily in photography, the result is a negative covered with fine lines. The red in the subject acts on the sensitive plate only through the red lines of the screen, the green through the green and blue through the blue. If there is a yellow in the subject, yellow being a mixture of red and green, the action would be through the red and green lines. In like manner any color of nature would act through the lines that, by their combination in part or in whole, are required to make such a color. After the negative is made, a positive or transparency, as it is commonly called, is made from this negative, and on this positive a screen similar to the taking screen, or the taking screen itself, is placed. The lines registered, the result is a most correct and beautiful representation of the subject viewed by the camera.

In this picture we have the beautiful picture as seen on the ground glass of the camera, and so often admired and wished for by all lovers of this art. The picture on the ground glass is always more beautiful than when seen outside by the naked eye, for when viewed on the ground glass everything is condensed and the eye sees the whole scene at once, but when viewed outside it only sees a very small part of the view, thereby losing the brilliancy of the whole effect. This is why the comment has often been made of the McDonough pictures that they are too brilliant. A comparison of his pictures and those viewed on the ground glass has often been made, and the views were found alike in every instance. The paper pictures are equally beautiful. The paper is ruled in colored lines and the sensitive emulsion placed over it. It is then ready to print a colored photograph as follows: The negative made originally through the color screen is placed over this paper and registered (very easily by a special device) and is placed in the sun to print, as ordinarily. It is then toned and fixed in the old way, and the result, as by magic, is a beautiful photograph in color. Again, all the beautiful pictures in the periodicals of the day can be rendered in color with but one impression of black ink. The printing paper is ruled in the three colors, and from the original negative a half-tone plate is made. This is placed in the press and inked with black ink. The impression is now made on this ruled paper, which is registered by special arrangement, and the result is a beautiful half-tone picture in natural colors. The entire process is very simple, and its rapid manipulation commends itself to the printing world as the most rapid and faithful, as well as economical, way of producing pictures in color. The wide range of this valuable invention can scarcely be comprehended, and as every part of it has been thoroughly demonstrated there can be little doubt as to its practicability and early adoption by the photographic and printing industries.

EXTENSION OF NIAGARA FALLS POWER COMPANY'S PLANT.

It is interesting to note that the accompanying portrait is a half-tone reproduction of a photograph made from a negative taken by Mr. McDonough's process.

An electric light plant is projected at Ord, Neb.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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HIGH WATER MARK

CIRCULATION, 20,000.

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With the Niagara Falls convention number of the Western Electrician, dated June 12, 1897, this journal made a new record for itself both in circulation and advertising. Of this 100-page number 20,000 copies were printed and circulated and the amount of full paid advertising matter carried was 8,643 square inches.

The remarkable success of this journal, especially in view of the hard times that have prevailed throughout the country, is all the more striking because of the fact that it is only 10 years since the first number was issued. Its advancement has been rapid and in keeping with the progress of the great industry it represents and the splendid field which it occupies. It is a noteworthy fact, especially in view of existing conditions, that during the period of depression this journal has made steady gains in advertising. Beginning with the convention number of March 3, 1894, the record shows constant gains each year until in the present case the number of square inches of full paid advertising matter is more than double that of the 1894 number. The figures showing this unprecedented gain are given in the accompanying table:

Issue.	Number of Advertising Pages.	Whole Number of Pages.	Square Inches of Paid Advertising Matter.
March 3, 1894....	40	56	4,145
February 23, 1895.	52	68	5,593
May 9, 1896.....	72	88	7,576
June 12, 1897.....	80	100	8,643

This constantly increasing patronage speaks eloquently of the influence and merit of this journal and of the confidence and respect which it commands throughout the country. It is pleasing recognition of the efforts that have been made in the interest of the entire fraternity.

The American Institute of Electrical Engineers is holding its general meeting this week. The attractions are many and there is reason to anticipate an interesting and successful meeting. The programme, it will be remembered, was printed in the Western Electrician of July 17th, and a perusal of this would in itself convey some idea of the character of the meeting. The papers themselves, at least those that were distributed in advance, confirm the good impression and support the belief that the meeting will prove an important event in the history of the Institute. The fact, too, that the meeting commemorated the work of Prof. Farmer lent additional interest to the gathering.

Mention was made last week of a decision by the Appellate Division of the Supreme Court at Brooklyn, upholding the validity of an ordinance fixing the rate of speed at which trolley cars might be operated in the public thoroughfares of the City of Churches. Now the Supreme Court of Pennsylvania announces that it is not prepared to lay down any rule in regard to the rate of speed at which an electric car may be run between crossings, nor to say that the mere fact that a car was moving faster than usual at the time of an accident, which was the cause of the suit, would be "sufficient to justify" the jury in finding the company guilty of negligence. It thinks all that can be safely said upon this subject is that the car must be kept well in hand, and that the speed must not be so great as to make this impossible, or to endanger the safety of the public using the streets with reasonable care. It will be seen, therefore, that in this particular it coincides with the New York tribunal. Continuing, the court says that these passenger railways are created to facilitate the movements of the general public and to furnish rapid transit for citizens from their homes to the business center of the city. They are practically indispensable in all great cities. The same rules as to speed that may be applied to ordinary vehicles propelled by horses are not applicable to street cars. The latter move upon a track from which they cannot turn, which is plainly visible, and which is prepared with a view to the rapid movement of cars upon it. The cars can be seen and heard for considerable distances, and are required to warn persons who may be upon their tracks of their approach. The purpose of their owners and the demand of the public are that the greatest rate of speed consistent with the safety of other persons using the street or highway shall be maintained; and so the court declares that it is unable to say that any rate of speed that does not transcend these limits is negligence, or should be submitted to the jury as "sufficient to justify" a verdict against the railway company.

Economy in central station management requires close attention to details that only a few years ago would not be considered worthy of notice. This change is in keeping with the advancement that has been made in other industries, as pointed out by Mr. Thayer in his paper on "Utilization of Exhaust Steam," in which he says that in some lines manufacturers may be said to make their entire profits from the wastes of a few years ago, and yet four-fifths of the electric light stations, he adds, are wasting a by-product of greater relative value than any other industrial concern. This, it is needless to point out, is the exhaust steam. In considering how this energy can be put to some commercial use, it must be admitted that some important changes will be required in central station practice. To begin with, there will be some modifications of central station design when steam heating is added. The boiler portion of the plant will become of much greater importance, and wastes which otherwise would be small will assume greater importance when the work done by the boilers is more than doubled. Here, too, it is pointed out, the use of storage batteries will assume a new importance. In alternating plants it will be necessary to provide a direct-current load during the heavy lighting hours if batteries are used. At the same time it must be admitted that the high cost of the battery and the unwillingness of the smaller stations to make large increase in their investment for the sake of economical operation will deter many from taking up this subject. Mr. Thayer calls attention to the fact that once a heating system is in operation, it becomes much easier to secure a paying power or day lighting load. During the heating season the machinery can be run at a small additional expense, and with the coming of the warm months the fan motor business can be made to tide over the summer months when the station must be run daytime for power alone. The trend of central station practice seems to be along the lines of extending the hours for the use of the output. Mr. Thayer concludes that the ideal station should furnish light, heat, power, and, if necessary, artificial refrigeration, and he contends that as long as the station confines itself to light, with power as a side issue, the interest and depreciation alone will wipe out profits.

It is proposed to appeal the Indianapolis street railway case, noted in the last issue of the Western Electrician, and secure a review of Judge Showalter's decision by the Supreme Court of the United States. The decision in the Indianapolis case holds that it is special legislation to pass an act applying only to a city described by the number of its inhabitants. It is said that the city might as well be mentioned by name as to be designated by its population. The three-cent act of the Indiana Legislature applied only to cities of 100,000 inhabitants or over, according to the census of 1890, and, therefore, it was directed against Indianapolis, as the description did not fit any other city in the state. Should the decision be upheld by the Supreme Court of the United States, it would invalidate a considerable number of statutes now in force in other states, and for this reason much general interest is displayed in the outcome of this litigation. Statutes relating to cities designated by the class to which they belong, according to their population, are passed in evasion of the inhibition placed by the constitution on the enactment of special laws. Many acts of this kind have been passed by the Illinois Legislature, and the general statutes have many chapters containing the same conditions. These will all have to be overhauled should Judge Showalter's findings be sustained.

Another feature of this case of scarcely less importance is the ruling to the effect that the franchise of the Indianapolis Street Railway company, giving it the right to charge a five-cent fare, is a contract and cannot be abrogated by legislative action. This raises a point of great importance to the people of nearly every municipality in the country, namely, whether rates of fare can be altered by the governing authorities after having been once stipulated in the franchise. If rates can be so altered, Chicago, for instance, may yet secure reduced fares, even if the City Council shall pass ordinances favorable to the street railway companies, as empowered to do by the Allen law.

It may be well to sound a note of warning to street railway men upon this subject. Discontent is everywhere manifest, and the demands for a three-cent fare are growing louder every day. It can only be a question of time when some concession must be made.

Electricity as a Motive Power on Elevated Railways.

By S. H. Short.

The elevated railways of New York, Brooklyn and Chicago were built to satisfy a crying demand for rapid transit from the business centers to the suburban districts of these great cities. So long as they had for their only competitor the slow-moving horse car they were considered a great convenience, notwithstanding that one was obliged to walk from one to three blocks and climb a difficult flight of stairs to reach these rapidly moving trains.

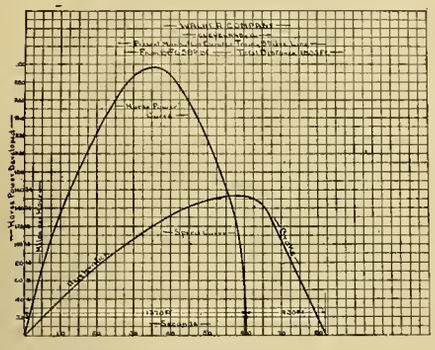
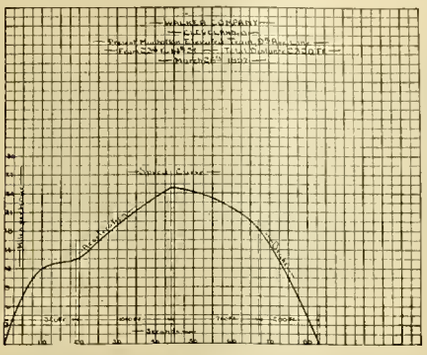


Fig. 1.



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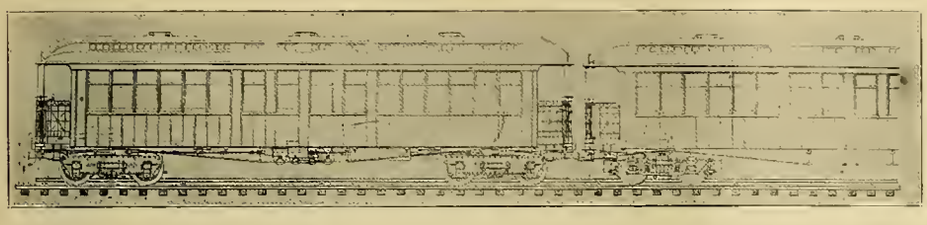


Fig. 3.

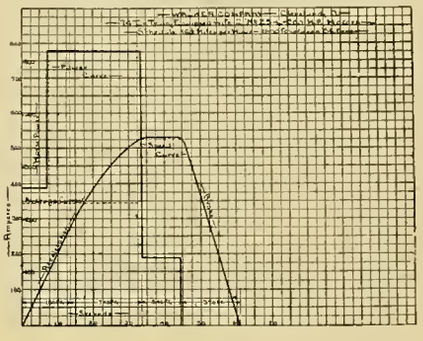


Fig. 4.

ELECTRICITY AS A MOTIVE POWER ON ELEVATED RAILWAYS.

Since the trolley car has come into general use people have been educated to a still more rapid rate of travel, and where the trolley car parallels the elevated railway, as in Brooklyn and Chicago, the frequent, speedy and accessible surface car is, by far, the more popular. In New York, however, the elevated railways still enjoy a very large traffic, because the electric cars do not parallel their lines, nor are the facilities for transportation yet sufficient for the enormous masses to be moved back and forth in that city. However, the surface lines are soon to be equipped electrically, and their carrying capacity thereby enormously increased, to the detriment of the elevated railway travel. In order to retain their traffic, it will be necessary for the elevated railways to move their trains more frequently and at a much greater rate of speed, to compensate the traveling public for being obliged to walk some distance and climb those disagreeable stairs. It would add greatly to the travel on these roads were some plan devised for mechanically lifting passengers to the elevated stations.

The elevated roads are all built on the same general plan, the structure being provided with double track throughout the entire length, with stations about one-third mile apart. The grades are slight and the curves of not less than a 90 foot radius. The structure is made to safely carry the standard elevated train, i. e., five passenger coaches, each 46 feet in length, weighing, when loaded with 75 passengers, 20 tons; drawn by a locomotive weighing 23½ tons; making a total of 123½ tons for the complete train.

The locomotives are constructed so that 65 per cent. of their weight, or 15¼ tons, is upon their drivers, giving an adhesion and therefore a maximum horizontal effort for accelerating the train of 7,650 pounds. This effort is used for accelerating the train for 50 or 60 seconds, and a speed of 20 to 25 miles per hour is attained, while a maximum of 300 horse power is developed by the locomotive. The brakes are then applied with a negative acceleration and the train is brought to a standstill at the next station, where it remains on an average of 13 seconds.

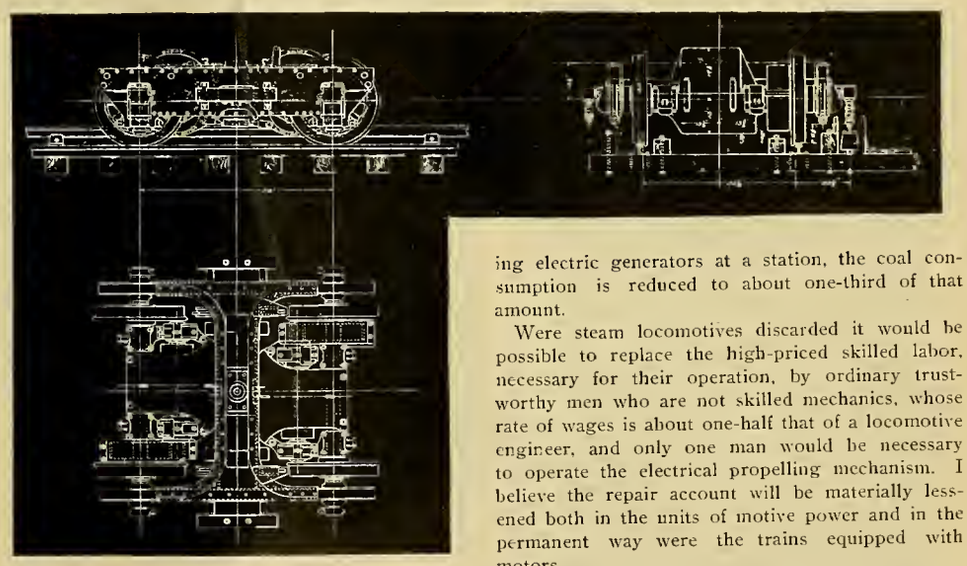


FIG. 5. ELECTRICITY AS A MOTIVE POWER ON ELEVATED RAILWAYS.

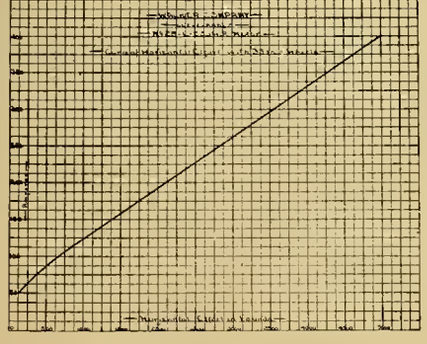


Fig. 7.

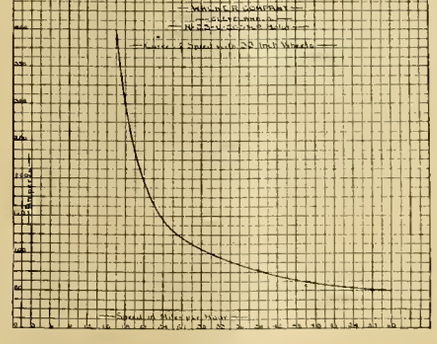


Fig. 6.

ELECTRICITY AS A MOTIVE POWER ON ELEVATED RAILWAYS.

In the accompanying diagrams, Figs. 1 and 2, I have illustrated graphically the performance of one of these trains, between stations, also the consumption of power as calculated from the weight and speed of the train. It will be seen therefrom that it is not possible, with steam, to make a better schedule time than is at present in force, 13½ miles per hour, unless the weight of the locomotive be increased or the trains be lightened. The heavier locomotives would endanger the safety of the entire structure. The lighter loads would necessitate more frequent trains, consequently a much larger force of skilled employes to run the extra locomotives. The cost of fuel for operating a steam locomotive amounts to about 20 per cent. of the total operating expenses of these roads, the fuel consumption being about seven to eight pounds of coal per horse power per hour.

With good compound condensing engines, driving electric generators at a station, the coal consumption is reduced to about one-third of that amount.

Were steam locomotives discarded it would be possible to replace the high-priced skilled labor, necessary for their operation, by ordinary trustworthy men who are not skilled mechanics, whose rate of wages is about one-half that of a locomotive engineer, and only one man would be necessary to operate the electrical propelling mechanism. I believe the repair account will be materially lessened both in the units of motive power and in the permanent way were the trains equipped with motors.

The care of a steam locomotive is very onerous, the average run being only about 100 miles, when it must be thoroughly overhauled and inspected by skilled mechanics before being used again. Contrast with this the all-day service of most electric motors—two or three hundred miles a day for days and weeks without inspection, cleaning or care of any kind.

The standard electrical equipment for an elevated train consists of the present elevated car, as illustrated in the accompanying drawing, Fig. 3, provided with two swiveled trucks of special construction, arranged to receive electric motors of a type adapted especially for this service. The wheels of the trucks are 33 inches in diameter, and the wheel base does not exceed six feet for the largest motors, and is reduced to five feet six inches where motors of the smaller size are used. The weight of the motor car loaded to its full capacity with passengers is 32 tons, including trucks, motors and the electrical equipment.

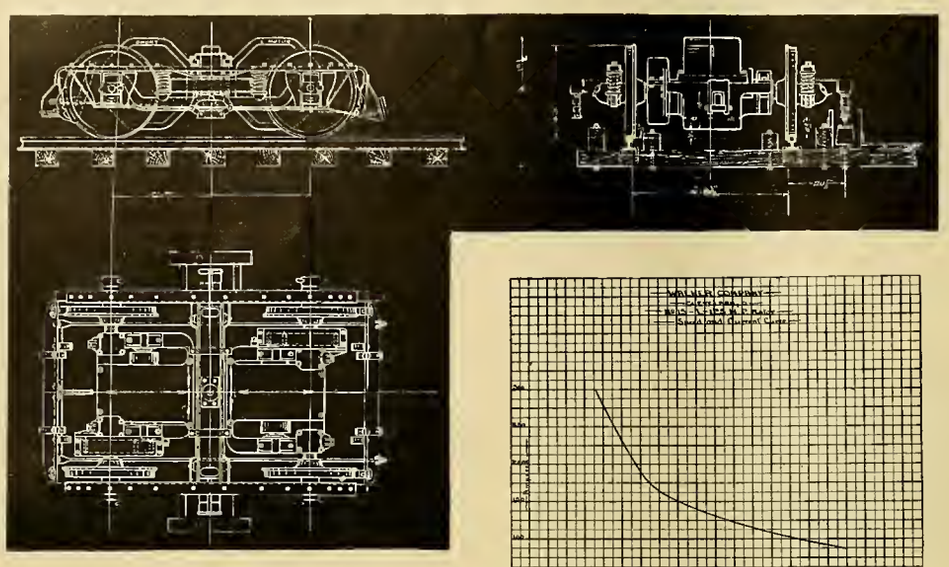
In most cases it is advisable to use only two motors upon a motor car, and both should be placed on one truck for convenience in repairing. There is, therefore, 19½ tons upon the drivers, or 61 per cent. of the total weight of the motor car, which corresponds favorably with the percentage of the total weight of passenger locomotives upon their

drivers. This gives an adhesion and, therefore, a maximum practical horizontal effort for the motor car of 9,750 pounds, or a total possible horse power of 400, in accordance with standard motor rating.

This pair of motors is, therefore, capable of accelerating a train of three standard elevated cars at the rate of 1.85 feet per second, and of making a schedule of 16½ miles per hour, including stops, as illustrated graphically by the accompanying diagram, Fig. 4.

If the other truck of the motor car is also equipped with motors, a train of double this size will operate in exactly the same manner and one more car may even be added, because the tractive effort required per ton decreases materially as the number of cars in the train increases, there being but one motor car on the train. It is not advisable to use more than two motors, owing to the complications which arise in the controlling devices.

The requirements of the service to be rendered on the different elevated railways necessitate very careful consideration being given to the size of the motor to be used upon the different roads.



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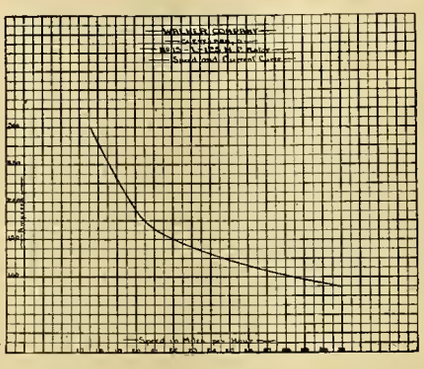

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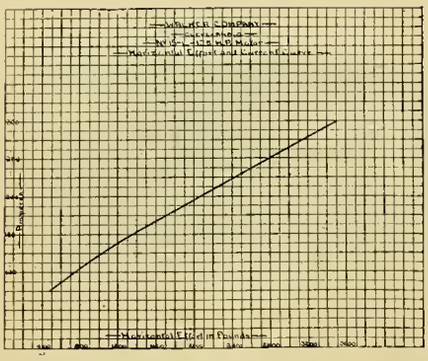
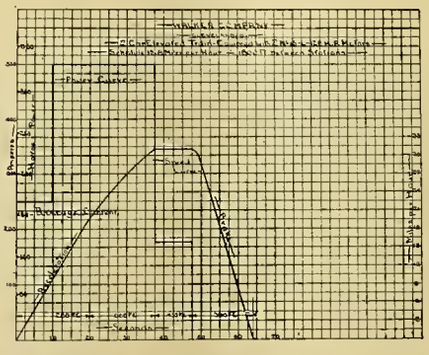


Fig. 10.



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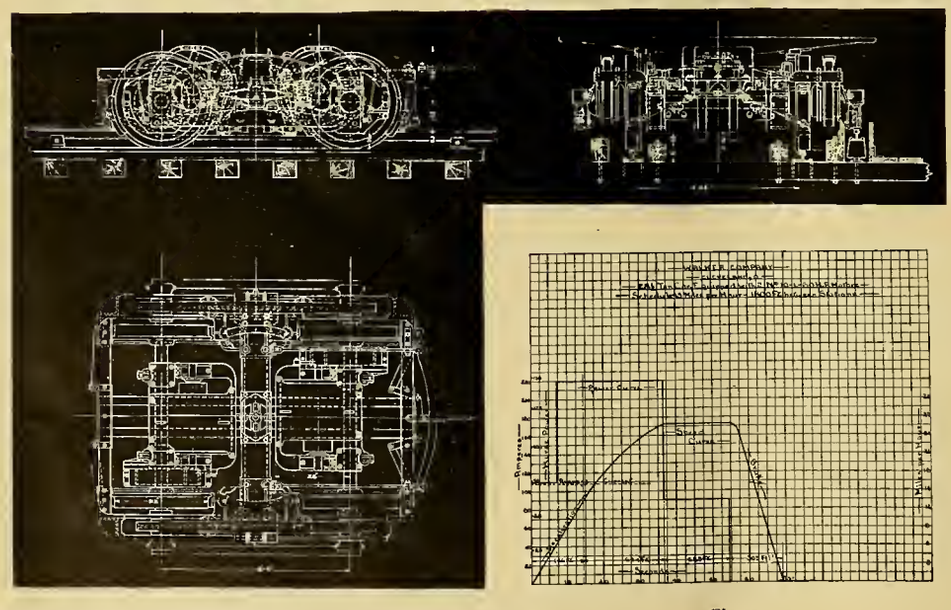


Fig. 12.

Fig. 13.

ELECTRICITY AS A MOTIVE POWER ON ELEVATED RAILWAYS.

There seems to be no question about the advisability of using as large a motor as possible upon a road like the Sixth avenue in New York, where the travel is constant throughout the day, and trains of from four to five cars can follow each other at short intervals all day. But in Brooklyn and Chicago, where the traffic is heavy during short periods of time, and light during a larger part of the day, it seems desirable that trains of few cars, or even single motor cars, shall be run at frequent intervals without a printed timetable; thereby practically securing a high-speed street-car service on the elevated structure.

Another reason for frequent and light trains is that these roads have branches, which, by this method, would be served to better advantage.

It is possible, also, that these single motor cars or short trains may be coupled into longer trains during the rush periods of the day, and be operated from the front platform by one motorman, if a suitable controlling apparatus is provided, by means of which all of the motors of the train can be simultaneously controlled.

A motor of much smaller size than would take up the full adhesive power of the truck could be used, where this method of equipment is adopted. It, however, has the disadvantage of multiplying the electrical apparatus necessary to move the rolling stock of the road. It will also consume more power per ton-miles of train, because the tractive effort per ton of the trail cars is about half that required by the motor cars, the difference being due to the friction, windage, etc., of the motor cars.

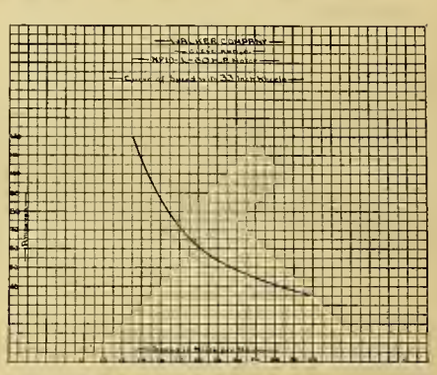


Fig. 14.

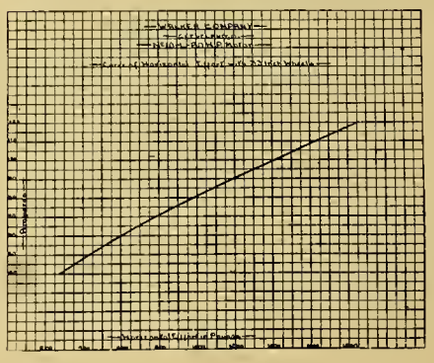


Fig. 15.

Standard Elevated Ry. Cars.

Number of Cars	Accelerating Current	Full Speed Current	Average Current	Average Horse Power
1	220	90	180	121
2	500	175	227	152
3	780	190	348	231

Fig. 16.

ELECTRICITY AS A MOTIVE POWER ON ELEVATED RAILWAYS.

The accompanying drawing, Fig. 5, illustrates the Baldwin standard elevated truck, equipped with two standard 200 horse power "L" motors, which we have recently designed for this work. These will operate a standard elevated train of three cars, fully loaded, at a schedule speed of 16½ miles per hour. We also give train data sheet (marked Train No. 1) for this equipment, and speed and horizontal effort curves, Figs. 6 and 7, for the motors. The next drawing, Fig. 8, is a standard Jackson & Sharp truck, equipped with two 125 horse power "L" motors, of the same design, capable of moving a standard elevated train of two cars, fully loaded, at a schedule speed of 16 miles per hour. A train data sheet (Train No. 2) and curves, Figs. 9, 10 and 11, for this equipment, are given. The next drawing, Fig. 12, shows two 60 horse power motors of the "L" type, mounted upon a standard McGuire truck, capable of operating a single standard elevated coach at a schedule speed of 15½ miles per

hour, with its corresponding train data sheet (Train No. 3) and curves, Figs. 13, 14 and 15.

For the convenience of engineers making calculations for the required current in amperes at 500 volts pressure, which will be necessary to operate a given line of road with trains as specified, we give a table (Fig. 16) showing the maximum current consumed by trains during acceleration, the current necessary to operate the trains at full speed, and the average current and horse power for the various trains.

DATA OF OPERATION.

TRAIN NO. 1.

No. of cars in train	3	
Full speed of train on level track (miles per hour)	31	
Average speed, stops one-tbird mile apart (do.)	16.5	
MOTOR CAR.		
Weight of motor car body	10	tons
Weight of both trucks	10	tons
Weight of two motors	7	tons
Weight of 75 passengers	5	tons
Total weight of loaded motor car	32	tons
Number of motors on motor car	2	
Commercial rated power of each[1]	200	h. p.
Safe constant load for each	100	h. p.
Safe temporary tractive effort of equipment	10,000	lbs.
Safe constant tractive effort of equipment	3,500	lbs.
Weight on drivers	19.5	tons
Ratio of weight on drivers to total weight	26	%
Adhesive power	9,750	lbs.
Ratio safe temporary tractive effort to adhesion	100	%
Ratio safe constant tractive effort to adhesion	36	%
COMPLETE TRAIN.		
Total weight of loaded motor car	32	tons
Weight of two coaches	32	tons
Weight of 150 passengers in coaches	10	tons
Total weight of loaded train	74	tons
Maximum horizontal effort in accelerating train	9,750	lbs.
Horizontal effort per ton during acceleration	132	lbs.
Maximum power in accelerating uniformly to full speed	412	h. p.
Maximum current at 500 volts accelerating uniformly to full speed	780	amp.
Time required in accelerating uniformly to full speed	34	sec.
Distance in which train will acquire full speed	900	feet
Horizontal effort, train running uniform speed	1,300	lbs.
Power consumed, train running uniform speed	106	h. p.
Tractive effort per ton, running uniform speed	18¼	lbs.
Maximum practical negative horizontal effort in braking	13,800	lbs.
Time required to bring train to full stop	16	sec.
Distance traversed by train during braking	370	feet

TRAIN PERFORMANCE.

Track.	H. P.	Current at 500 volts.	Speed in miles per hour.	Horizontal effort.
Level	106	190 amperes.	32	1,300 lbs.
1% grade	170	290 amperes.	22	2,780 lbs.
2% grade	235	400 amperes.	20.8	4,260 lbs.
3% grade	295	505 amperes.	19	5,740 lbs.

1. This motor will deliver the commercial rated output for one hour without heating more than 75 degrees C. above the surrounding air.

TRAIN NO. 2.

Number of cars in train	2	
Full speed of train on level track (miles per hour)	31	
Average speed, stops one-third mile apart (m. p. h.)	15.8	
MOTOR CAR.		
Weight of motor car body	10	tons
Weight of both trucks	10	tons
Weight of two motors	5.5	tons
Weight of 75 passengers	5	tons
Total weight of loaded motor car	30.5	tons
Number of motors on motor car	2	
Commercial rated power of each[1]	125	h. p.
Safe constant load for each	60	h. p.
Safe temporary tractive effort of equipment	5,600	lbs.
Safe constant tractive effort of equipment	1,600	lbs.
Weight on drivers	18	tons
Ratio of weight on drivers to total weight	35	%
Adhesive power	9,000	lbs.
Ratio safe temporary tractive effort to adhesion	62	%
Ratio safe constant tractive effort to adhesion	18	%
COMPLETE TRAIN.		
Total weight of loaded motor car	30.5	tons
Weight of one coach	16	tons
Weight of 75 passengers in coach	5	tons
Total weight of loaded train	51.5	tons
Maximum horizontal effort in accelerating train	5,640	lbs.
Horizontal effort per ton during acceleration	109	lbs.
Maximum power in accelerating uniformly to full speed	280	h. p.
Maximum current at 500 volts accelerating uniformly to full speed	500	amp.
Time required in accelerating uniformly to full speed	37.5	sec.
Distance in which train will acquire full speed	953	feet
Horizontal effort, train running uniform speed	1,000	lbs
Power consumed, train running uniform speed	115	h. p.
Tractive effort per ton, running uniform speed	19.7	lbs.
Maximum practical negative horizontal effort in braking	11,000	lbs.
Time required to bring train to full stop	16	sec.
Distance traversed by train during braking	390	feet

TRAIN PERFORMANCE.

Track.	H. P.	Current at 500 volts.	Speed in miles per hour.	Horizontal effort.
Level	92	175 amperes.	31	1,013 lbs.
1 % grade	135	250 amperes.	24.8	2,043 lbs.
2 % grade	176	320 amperes.	21.3	3,073 lbs.
3 % grade	220	390 amperes.	19.9	4,103 lbs.

1. This motor will deliver the commercial rated output for one hour without heating more than 75 degrees C. above the surrounding air.

TRAIN NO. 3.

Number of cars in train	1	
Full speed of train on level track (miles per hour)	26	
Average speed, stops one-third mile apart (do.)	15	
MOTOR CAR.		
Weight of motor car body	10	tons
Weight of both trucks	10	tons
Weight of two motors	3.5	tons
Weight of 75 passengers	5	tons
Total weight of loaded motor car	28.5	tons
Number of motors on motor car	2	
Commercial rated power of each[1]	60	h. p.
Safe constant load for each	25	h. p.
Safe temporary tractive effort of equipment	3,300	lbs.
Safe constant tractive effort of equipment	700	lbs.
Weight on drivers	16	tons
Ratio of weight on drivers to total weight	56	%
Adhesive power	8,000	lbs.
Ratio safe temporary tractive effort to adhesion	41	%
Ratio safe constant tractive effort to adhesion	8	%
Maximum horizontal effort in accelerating train	2,600	lbs.
Horizontal effort per ton during acceleration	91.5	lbs.
Maximum power in accelerating uniformly to full speed	122	h. p.
Maximum current at 500 volts accelerating uniformly to full speed	220	amp.
Time required in accelerating uniformly to full speed	36.5	sec.
Distance in which car will acquire full speed	810	feet
Horizontal effort, train running uniform speed	712	lbs.
Power consumed, train ruoning uniform speed	51	h. p.
Tractive effort per ton, ruoning uniform speed	25	lbs
Maximum practical negative horizontal effort in braking	5,300	lbs.
Time required to bring train to full stop	14.5	sec.
Distance traversed by trainduring braking	305	feet

TRAIN PERFORMANCE.

Track.	H. P.	Current at 500 volts.	Speed in miles per hour.	Horizontal effort.
Level	51	90 amperes.	26	712 lbs.
1% grade	68	124 amperes.	19.9	1,282 lbs.
2% grade	85	154 amperes.	17.2	1,832 lbs.
3% grade	101	182 amperes.	15.5	2,422 lbs.

MOTOR BEST SUITED TO ELEVATED SERVICE.

There being neither dust nor water to contend with, the motor can be left entirely open, for the free circulation of air over the armature and field magnets, and not only thorough ventilation but 20 per cent. more output can be obtained from a given machine in this way. The open motor can be much more easily inspected and kept free from oil and grease. The accompanying drawing, Fig. 17, shows the form of motor which I have designed for elevated railway service.

This motor is intended to be taken apart by running the truck from under the car, and lifting the uper half of the magnetic ring by means of an overhead crane; this exposes the armature, left with its bearings in the motor frame, which is journaled to the car axle at one side and supported by the truck bolster at the other side. The motor frame has cast integral with it the lower half of the magnetic ring. Each half of the magnetic ring has two pole-pieces, wound with a few turns of heavy copper ribbon, so that the magnetic system of the motor is symmetrical and of very large sectional area, to provide for the rapid acceleration control, which will be discussed later.

The magnetic ring is large in diameter and the axle is made to pass inside the ring, between the magnet coils, so that the distance between the gear centers is short. This makes the gears small in diameter and gives a large clearance above the stringers inside the rails.

The armature is especially large and heavy, provided with deep slots to secure the bar winding, which makes but one turn per commutator bar. By this means the self-induction of the armature windings is reduced to a minimum, and there is a very low voltage between the commutator bars, providing for perfectly sparkless commutation.

Bronze is used for both the armature and axle

Comparative Table of Steel and Copper Feeders.

Steel Rails		Equivalent Copper Cable		Current Transmitted 1 Mile 100 Volts Drop	Horse Power Transmitted
Lbs per Yard	Cost per Mile	C. M.	Cost per Mile		
50	$ 774	910000	$2090	1640	1100
55	851	1000000	2300	1800	1210
60	928	1091000	2510	1970	1320
65	1005	1182000	2720	2130	1430
70	1110	1273000	2930	2300	1540
75	1188	1364000	3140	2460	1650
80	1268	1455000	3350	2620	1760
85	1450	1546000	3560	2790	1870
90	1535	1637000	3770	2950	1980
100	1705	1819000	4190	3280	2200

Fig. 21.

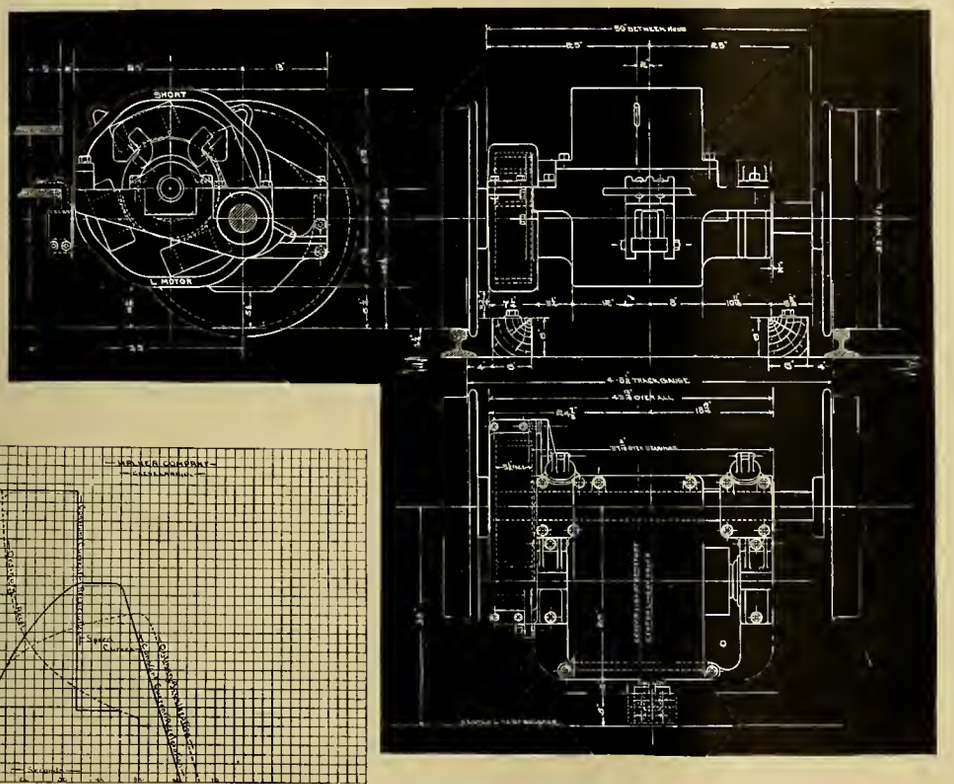


Fig. 17.

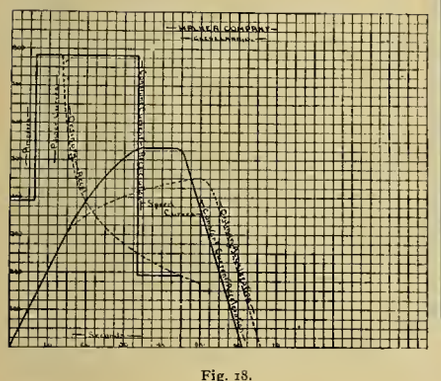


Fig. 18.

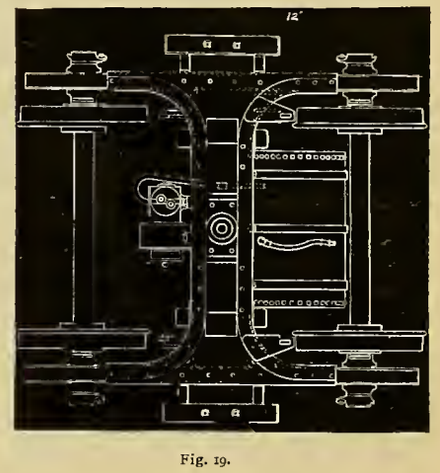


Fig. 19.

bearings, and the lubricant is oil instead of grease. The brasses are so arranged that the thrust caused by the gears brings the shafts against solid unbroken surfaces. The oil is stored in cellars and is carried to the bearings by means of waste, which wipes the entire length of the shaft within the brasses.

Provision is made at the ends of the bearings to collect all of the oil which may escape and return it to the cellars to prevent a drip on the structure and street beneath. The bearings are made exceedingly long and the shafts are large in diameter, the pressure per square inch being reduced to the very low value of 37 pounds.

The armature bearings are solid and are lifted out of the motor together with their oil cellars when the armature is removed by an overhead crane.

The gear housing is made of heavy cast-iron in halves, the lower half being permanently fastened to the motor frame, while the upper half may be lifted off independently by the overhead crane. The housing is grease-tight and the gears run in oil.

The entire motor is cast from the best quality of steel.

THE CONTROL.

The motors are controlled by a series parallel controller, which provides for keeping a constant current through each of the motors, of such a quantity as will just avoid slipping the wheels during the time of acceleration. We have named this the maximum, constant current acceleration controller. In order to accomplish this kind of control, the counter electromotive force of the motors is prevented from rising until the train has reached the maximum speed at which it is desired to operate it. The counter electromotive force is then instantly raised to a point which reduces the current to a quantity which produces a horizontal effort sufficient to overcome the resistance of the train and maintain a constant speed.

The diagram, Fig. 18, shows the acceleration curve of an ordinary series parallel controller and two series motors; also a curve of the constant current method of control, with two motors of the same size. The advantages of this latter method are apparent in the decrease of the schedule time and the decrease of power consumption.

THE BRAKES.

Westinghouse automatic air brakes are used on all trains, with a brake applied to every wheel, enabling a train to be brought to a stop with a negative acceleration of three feet per second, which is not disagreeable to passengers.

The train pipe for this system of brakes is fed with air from a main reservoir attached to one side of the truck bolster of the idle truck of the motor car, as illustrated in Fig 19. On the other side of the truck bolster is attached an electric motor air compressor, as illustrated. The motor is arranged to automatically stop and start under the influence of the varying pressure in the main reservoir. The object of putting the air compressing apparatus on the truck instead of on the car body is to avoid the disagreeable noise due to the operation of the pump, and to facilitate repairs, as the truck with its entire air compressing outfit is run out from under the car in the same manner as the motor truck.

THIRD-RAIL FEEDER SYSTEM.

A third rail of varying section should be mounted throughout the entire length of the road on substantial insulators. Heavy rails should be laid near the station and gradually taper off to the ends of the road. For most "L" roads, it is not necessary to use auxiliary feeders of any kind, as the entire power necessary to operate all trains can be carried by the third rail. This rail should be placed on one side of the track, with its head some inches above the track rails, so that sliding shoes made of cast-iron and attached to the trucks may slide freely upon their upper surface (Fig. 20).

The appended table, Fig. 21, shows the amount of power which rails of different sections can carry, with a drop of 100 volts per mile, when all the power is delivered at the end of the mile. Of course the same amount of power can be distributed with the same drop over two miles of track. The table also shows the relative cost of this method of distribution as compared with copper feeders.

BONDING.

All rails, as far as practicable, should be in 60 foot lengths. The third rail, as well as the track rail, joints should be bonded by a flexible copper bond, attached to the under side of the foot of the rail by means of a number of rivets, and the area of contact with the rail should be sufficient to provide that not more than 100 amperes per square inch should be required to pass through the joint between the steel and copper.

The sectional area of the bond must be one-sixth the sectional area of the rail itself.

The track rails should be electrically connected frequently with the elevated structure.

Care should be taken that all joints between copper and steel should be made with clear, bright surfaces and no space be left to admit water or air to corrode the joints.

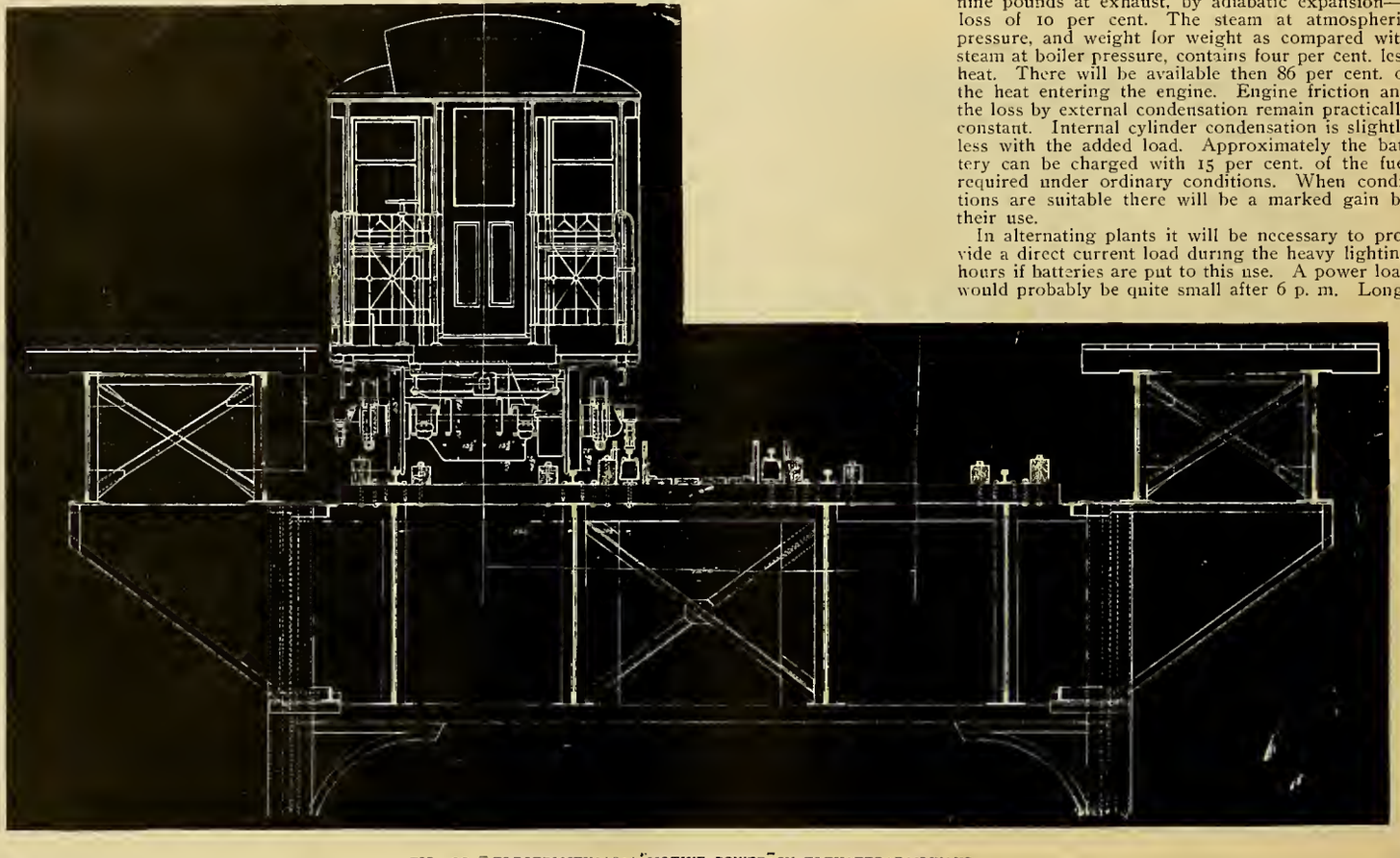


FIG. 20.—ELECTRICITY AS A MOTIVE POWER ON ELEVATED RAILWAYS.

Utilization of Exhaust Steam.

[*Continued from page 60.*]

high-speed simple engines not adapted to working condensing, this question need not be discussed.

The use of storage batteries in connection with a heating plant assumes a new importance. It can safely be assumed that during the hump of the load more steam will be used by the engines than can be discharged into the heating system. A storage battery can be used to take a portion of the load during the time. Later in the night, when the heating must be done in part with live steam, it can be charged at a very small expense for fuel. Assuming boiler pressure 100 pounds and temperature of water from heating system at 180 degrees, one pound of steam entering the engine becomes nine pounds at exhaust, by adiabatic expansion—a loss of 10 per cent. The steam at atmospheric pressure, and weight for weight as compared with steam at boiler pressure, contains four per cent. less heat. There will be available then 86 per cent. of the heat entering the engine. Engine friction and the loss by external condensation remain practically constant. Internal cylinder condensation is slightly less with the added load. Approximately the battery can be charged with 15 per cent. of the fuel required under ordinary conditions. When conditions are suitable there will be a marked gain by their use.

In alternating plants it will be necessary to provide a direct current load during the heavy lighting hours if batteries are put to this use. A power load would probably be quite small after 6 p. m. Long-burning arc lamps could be installed very successfully in this connection. In this case a good construction would be made with a 220 volt power circuit and a three-wire system for the arc lamps. Close regulation not being necessary, considerable complication due to cells and boosters could be avoided.

The generator might in some cases be used as a motor during the heavy lighting load, in the absence of an arc light or power load for the batteries.

To offset these advantages is the high cost of the battery and unwillingness of the smaller stations to make large increase in their investment for the sake of economical operation.

Once a heating system is in operation, it becomes a much easier matter to secure a paying power or day lighting load. During the heating season the machinery can be run at a small additional expense; the principal items will be oil and the increased wear and tear. With the coming of the warm months a respectable fan motor business can be worked up, which will tide over the summer months when the station must be run daytime for power alone.

The trend of central station practice seems to be along the lines of extending the hours for the use of the output. The ideal station should be a dealer in light, heat, power, and, if necessary, artificial refrigeration. As long as the station confines itself to light, with power as a side issue, so long will the interest and depreciation eat into its earnings.

All bids for furnishing an electric light plant for the state agricultural farm at St. Anthony Park were rejected and new bids will be taken. C. R. Aldrich of Minneapolis is the architect.

Profitable Extensions of Electricity Supply Stations.[1]

By Arthur Wright.

Part I.

Perhaps it may seem rather bold for an Englishman to write a paper on a subject relating to the working of central supply stations in a country from which we all acknowledge came the first real impetus to practical electricity supply; but it occurred to the author that by so doing the managers of some of the American stations, in discussing the conclusions which experience has led the author to believe are sound, might throw some fresh light on one of the most vital questions we all have to meet.

If, owing to his ignorance of the special conditions and difficulties under which electricity has to be supplied on the continent of America, he has made some mistakes of detail, the author trusts the members will overlook them, so long as they do not vitally affect the main principles, on which their criticism is earnestly invited.

There are many central stations which, very soon after starting the supply, have to face extensions of plant and mains, and generally such necessity for extensions has been regarded as an unmistakable proof of commercial success. That this is not necessarily so, many of us have found, as it is obvious that no extensions are warrantable unless a definite profit can be assured from them.

No company should be called upon to supply electricity to anyone at a loss, notwithstanding the common impression that it is necessary in electricity supply business to take the bad customers with the good, and the author hopes to show in this paper that it is quite possible to devise a simple and equitable tariff by which a profit to the supply company, as nearly as is commercially practicable, is assured from every consumer; and, moreover, that only by adopting such a tariff of approximately equal rates of profit from all consumers can central station managers hope to get the use of electricity generally adopted for all the many purposes it naturally lends itself to.

The author also hopes to show that it is not only possible, but extremely easy, to do an enormously extended business in electricity supply in such a way as to yield substantial profits to the supply company, and at the same time to supply electricity to an ever-increasing number of consumers at rates which will insure large business, and in most cases to successfully compete with gas.

Hitherto the main governing idea among central stations managers seems to have been that electricity must rely upon its superiority as regards cleanliness, convenience and healthiness over its competitors for lighting purposes. The author hopes to convince the members that, in one of the richest fields open to central supply stations, electricity can compete with its rivals, even as regards price.

UNRECOGNIZED PROFITABLE FIELD FOR LARGE EXTENSIONS.

Owing to the enormous development of the business of electricity supply for power transmission, for traction and other purposes, many central station managers have lately devoted most of their energies to the supply of electricity for those uses, and have apparently assumed that they have already substantially secured the greater part of the lighting business they are likely to get in their districts. The author, on the contrary, firmly believes that there exists even a larger and more profitable field for electricity supply ready at hand in every town, waiting only to be tapped, and refers to the supply of light to the thousands of domestic lamps required by the middle classes in their homes, which are used regularly every day for several hours, summer and winter, and which, in many cases, can be replaced by electricity at the same price, or even less than the light now used, and at the same time yield substantial profit to the supply company.

This profitable domestic supply, which is largely used after business hours, need in no way interfere with the much-catered-for power supply, the value of which the author fully appreciates.

Another enormous field for profitable extensions is to be found in the smaller and lower classes of stores, saloons and business houses that trade until late in the evening. As these classes of consumers frequently live over their business premises, their use of artificial light is a very lengthy one; although their bills may be small, they form a most desirable class of possible consumers, and can be supplied at a rate that, although low enough to secure the business, will yet yield such a substantial profit as to far more than counterbalance the extra cost of connection and collection to such classes.

Central station managers are now seeking fresh markets and uses for electricity supply, neglecting the domestic lighting field, which has hardly yet been touched. This, the author considers, is mainly due to the habit that they have generally acquired, of regarding consumers collectively instead of individually, and estimating the cost of supplying any one class to be the average cost of supplying all classes, thereby overlooking that it is quite possible that more profit may be derived from the supply of electricity to small long-hour consumers at a low rate than from the supply of large consumers, such as extensive stores, at a much higher rate.

1. Read before the National Electric Light association, at Niagara Falls, N. Y., June 9, 1897.

IMPORTANCE OF THE TARIFF QUESTION.

The author doubts the possibility of much financial success attending the efforts of central station managers until they dismiss from their minds the idea that large consumers' bills necessarily mean large profits, as very frequently the reverse is the case. Although it seems a mere platitude to say that a small business with a large profit is better than a large business with small profit, yet this would not appear to have been generally realized, if we are to judge by the great inducements frequently given in the matter of discounts off heavy bills to consumers, irrespective of whether the conditions under which their electricity has been supplied have yielded a profit or a loss, while very little inducement, if any, has been offered to the small consumer, who requires light for long hours, in order to tempt him to use electricity for lighting purposes.

The author trusts it will not be imagined that, because he has expressed such a keen appreciation of the small long-hour consumer, he does not appreciate the large consumer having the same qualification. His contention is that, if an equal rate of profit be charged to all consumers of every class and size, the field for profitable extension is practically boundless.

In this paper the writer has tried to confine himself solely to the commercial considerations which govern the profitable extension of supply stations, he being firmly of the opinion that, while engineers have been devoting vast energy and time to considerations of coal and plant economy, they have neglected the easiest of all means for reducing the cost of supplying the electricity, viz., the adjusting of the charges so as to offer great inducements to the profit-yielding consumers and to charge as high a rate as possible to the unprofitable ones; this will assuredly broaden out the average load curve of the station and increase the usefulness of the investment. Although in large stations the question of coal economy comes almost next in importance to that of the necessity for absolute reliability of supply, the paramount consideration must always be the arranging of the tariff so as to attract the most profitable classes of consumers. The raw materials of electricity supply, coal, water and stores, have in many stations been brought down to a little over one cent per kilowatt-hour, and all the resources of engineering, so far as we now know them, can only help us to make a fractional improvement on that small figure.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the Western Electrician.]

The Western Minnesota Telephone company has been incorporated in Glencoe, Minn., with $30,000 capital stock, to establish a system connecting the principal towns of the county.

An alleged shortage of accounts of Frank Drake, secretary of the Inland Telephone and Telegraph company of Spokane, Wash., has been investigated, and all matters have been settled amicably. For a while Mr. Drake was shadowed by a detective, during the progress of the investigation.

The Northwestern Telephone Exchange company has just purchased the building which it has fitted up for headquarters in Minneapolis. The company held a 20 year lease, but decided to buy it outright.

Council Bluffs, Ia., now has long-distance connection with Chicago, New York and other eastern cities.

The Jefferson Telephone company is extending a line from Lake City, Ia., to Holstein.

The Board of Supervisors has decided to order out all Iowa union telephones in Sioux City, Ia., county offices, save one, and replace them with the Home Telephone company's instruments.

The Marshall Telephone company of Marshalltown, Ia., contemplates building lines to Tama and Story City, Ia.

The council of Lamoni, Ia., was petitioned to put in a municipal telephone system.

The telephone system of Beaver City, Neb., will be extended to Harlan county, connecting with Stamford, Orleans and Alma.

The Convention Number of the Western Electrician.

[From Modern Machinery.]

The special convention number of the Western Electrician is another example of the many which have been furnished by this standard journal of the energy and ability with which it is edited, and the estimate in which it is held by the electrical trade. This issue contains a hundred pages, and the extent to which the leading manufacturers of electrical machinery and electrical supplies are represented must be a source of much satisfaction to the publishers. The Western Electrician has won for itself the front rank among the very best technical journals in the country.

Lightning's Queer Pranks.

[From the New York Sun.]

Ansonia, Conn., July 24.—It was not until the latter part of last week that the frisky Connecticut lightning with a reddish tinge in its glare began to get in its work this season; but it had enough fun then to make up for lost time. It was in Goshen, at the upper end of the Naugatuck Valley, that it made its playground. The first flash that came in the storm just tried its marksmanship. Darius Thompson had been setting bean poles in his garden that morning, and one of them was particularly straight and handsome, somewhat taller than the others. The bolt singled out that particular bean pole, struck it on the tip end, and split it down to the other end, a foot or more underground.

Having satisfied itself of its aim and having got the range, it took another shot. This time it aimed at the lightning rod on Fred Williams' house. Eighteen inches of the top of the rod, including the copper point, was cut off as though it had been an icicle, and stuck into the roof several yards away. Then another section of the rod was clipped off, about eight feet of it, torn from its fastenings and rammed 10 inches into the ground, where it stood upright when Mr. Williams started to look for it. Having had its fun with the rod, the bolt followed down to within about two feet of the ground, where it parted, one section going into the ground with such force as to throw mud on the clapboards as high as the roof, while the other section tore out a piece of siding large enough to put a hand in, and began a trip of investigation.

The first room it came to was Miss Williams' bedroom. She had been lying on the bed a few minutes before, but had been called downstairs by her sister. The lightning tore off a section of lath and plaster, jumped down to the bed and tore every slat on it to kindling wood, ripping the headboard and footboard to pieces, and leaving not enough to make over into a bunk. Then the bolt bored its way into the parlor, where another bedstead had been put up for an emergency. It also struck this bed, tore off the brass casters, hacked huge splinters off the woodwork, and went through the mattress, quilt, and sheets. The family's dog was shut in a closet in this room, but the playful electricity sought him out and killed him. Then, having had fun enough, it broke two panes of glass in the lower window sash and went out.

This finished its work on the Williams farm, but it struck several trees in that section of the town and split them apart, tearing off the bark to the ground.

Struck by a "Streak" of Lightning.

[From the Galveston News.]

Orange, Tex., July 9.—Yesterday afternoon Charley Plant, a farmer living about four miles southeast of this place, rushed out during a light shower to frighten jackdaws away from his fig trees. As he stooped to pick up a stone to throw at the birds a streak of lightning struck him just below the right shoulder blade, ran under his arm around to his right breast, then down and out at his right foot. He was knocked senseless. The family carried him into the house. He remained paralyzed for several hours. Dr. Sholars was called, and after careful treatment restored to him the use of his limbs, but he is confined to his bed on account of a burn that extends from his right nipple down the side and along his right leg. His right foot is badly burned on the side and bottom.

Lightning Hit Negro, Missed Chicken.

[From the Tri-Weekly Kentucky Advance.]

"Dog" Will Moore reports a funny freak of lightning during a recent storm. He was holding a knife and a chicken in his hands, preparing to cut off the fowl's head. Lightning struck the knife, glanced off and shocked a negro 10 feet away, but failed to give Moore the slightest sensation. The chicken disappeared and was not found.

Shepherd and 63 Sheep Killed by Lightning.

[From the Topeka Daily Capital.]

Larned, Kan., July 10.—Hans Anderson, a herder, was killed by lightning on a sheep ranch seven miles southeast of Jetmore last night. Within a few feet of where the body was found were 63 dead sheep that had been driven into the pen and which had evidently been killed at the same time.

Fire and Police Telegraph Superintendents.

The second annual meeting of the International Association of Fire and Police Telegraph Superintendents will be held at Nashville, Tenn., on September 14th and 15th. The headquarters will be at the Maxwell House. It is hoped that a large attendance will be present. Valuable papers will be read, touching upon many important subjects connected with daily business experiences. Officers are to be elected for the coming year, and, to a great extent, the future welfare of the association depends upon a successful meeting at Nashville. The Old-time

Telegraphers and the United States Military Telegraph Corps will meet in Nashville at the same time. F. C. Mason of Brooklyn is the president of the association.

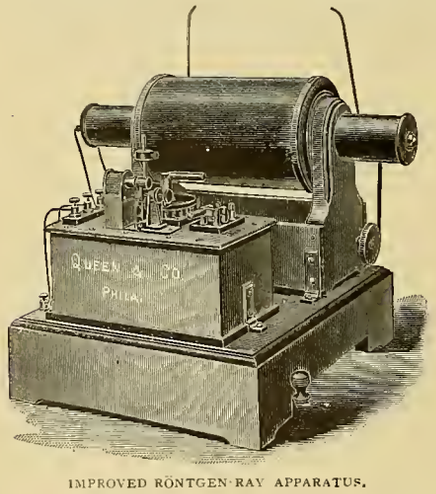
Improved Röntgen-ray Apparatus.

The increased demand by the medical profession for Röntgen-ray apparatus which may be used with ease and certainty, and applied without fear of failure to what are now considered difficult cases, such as fracture or dislocation of the hip, has led Queen & Co., Philadelphia, Pa., to institute in their laboratory a series of careful experiments for the improvement of this apparatus in the various parts. One of the most important results of these experiments is the Queen self-regulating X-ray tube, which was fully described in the Western Electrician of May 15th last. As further results important improvements have been made in induction coils, vibrators and condensers, and in the complete outfits. The cut shows the generating set complete.

In designing the new line of coils Queen & Co. have given careful attention to proportioning the different parts so as to get a heavy and continuous secondary discharge with the smallest possible amount of wire. As every improperly placed or unnecessary turn of wire in the secondary winding of an induction coil increases its resistance and cuts down the volume of the discharge without proportionately increasing the length of spark, this is a point of much importance, which has been too often overlooked in coil designing. The distribution of the wire on the secondary was determined by measuring the discharge from single coils of a few turns of wire, which were placed at intervals throughout the field of the primary. From the data obtained by these tests curves were plotted, showing the proper distribution of wire for coils of all sizes. Similar methods were used to determine the size and number of turns of the primary and the amount of iron in the core.

In the choice of insulating materials, and in assembling, the greatest possible care is used. Methods are employed which remove absolutely all air from the insulating material of the secondary. By this means it is not only impossible for the coils to break down, but small leaks which diminish the efficiency and may develop in time into serious breaks are entirely prevented.

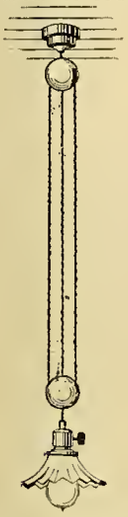
The induction coil has neither vibrator nor condenser, being intended for use with the adjustable condenser and independent vibrator described below. The spark points are adjusted by a hard-rubber disk at the left of the base, which is so well insulated that the operator is in no danger of receiving a shock even when the points are opened out to the full extent. The coil is finished throughout in polished mahogany and hard rubber.



IMPROVED RÖNTGEN-RAY APPARATUS.

The condenser and vibrator for use with coils of this type are mounted together. Two of the bindings posts are connected to the batteries, or lighting circuit, and the other two to the induction coil. The vibrator is operated by means of a small coil, which is a shunt from the main circuit. An independent set of contacts makes and breaks the circuit through this coil, and the switch near the binding post opens and closes the shunt circuit. The main circuit is controlled by the reversing switch.

In the vibrator, which is a very much improved form, the movable platinum contact is carried on a small vertical spring behind the vibrator spring. When the contact is made the movement of the vibrator is not arrested, as in other forms, but continues to its full amplitude, thus allowing a long 'make." The length of the "make" can be varied by screwing in or out the other platinum contact. The most important advantage of this arrangement is the suddenness of the "break," which is accomplished by the collar in the vibrator spring striking the movable contact while at full speed. In the old forms of interrupters the break was made when the vibrator started to move, consequently it was not only much slower, but did not make use of the momentum of the iron head of the vibrator. Sometimes the welding action of the current joined the two pieces of platinum so tightly that the magnetic pull was not sufficient to separate them. In the new form, as the break is made when the vibrator is at the middle of its swing, the sudden blow with the entire momentum of the vibrator head is always sufficient to break the platinums apart, and once started the vibrator continues in motion until the current is turned off. The suddenness of the break makes it possible to use this form of vibrator on the 110 volt as well as battery circuits; it also adds very greatly to the efficiency of the induction coil with which it is used. A rod screwed into the iron head carries a weight, which may be moved up and down and clamped in any position with a set-screw. By this means the rate of vibration may be varied within wide limits.



"TWO BALLS" INCANDESCENT LAMP ADJUSTER.

To summarize, the new vibrator has the following advantages over older forms: First—Its action is independent of the current going through the coil. Second—Its rate of vibration is adjustable. Third—It permits of a long 'make," and the length of the "make" and "break" are adjustable. Fourth—The "break" is very sudden, increasing the efficiency of the coils and making it thoroughly adapted to the 110 volt circuit. Fifth—It never sticks.

The outfits complete for X-ray work consist of a coil mounted on a base with rheostat if used for 110 volt circuit, and with an adjustable condenser and independent vibrator mounted on the same base, as shown by the cut. In addition to this a number of tubes, suitable stand, fluoroscopes, etc., are included with each set.

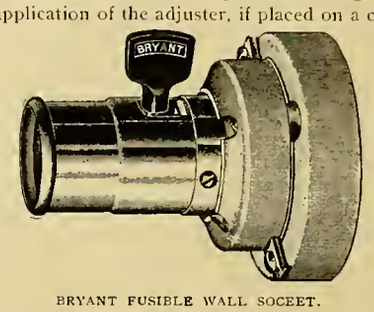
In making up these outfits Queen & Co. have aimed to combine the apparatus in such a way as to secure ease and certainty of operation, and at the same time powerful results.

Bryant Fusible Wall Socket.

The device illustrated is made by the Bryant Electric company of Bridgeport, Conn., and consists of the standard Bryant socket, mounted on a K. W. rosette, making a combination which will be found very useful, as it is fusible and can be furnished with either the key or keyless, Westinghouse or Thomson-Houston base. The shell of the socket is held in place on the base by three bayonet joints, which makes it thoroughly rigid and solid, capable of supporting any weight of shade or lamp without sagging. The socket, being fitted to the rosette cap, can be used with any of the regular rosette bases, all caps being interchangeable.

"Two Balls" Incandescent Lamp Adjuster.

The cut shows the "Two Balls" adjuster, made by M. I. Vought of 202 South Front street, La Crosse, Wis., attached to a common ceiling rosette. The light may be drawn down or raised at will, the lamp sustaining itself at any desired height. In this application of the adjuster, if placed on a ceiling of the usual height, there will be sufficient cord to permit the lamp being swung to any point in a common sized room, the adjuster automatically keeping the cord taut and up out of the way. A side swing attachment, known as the "Handy," is also provided by the same manufacturer. This, being adjustable, provides a means of fastening at any desired point of swing. In offices it is often the case that a single lamp hung in this manner can be used over different desks around the room, by swinging from the center of the room. The adjuster may also be connected to an attachment plug and thus secured into a fixture in place of a lamp. In this way the outfit makes an excellent reading lamp, bringing the light exactly where needed.



BRYANT FUSIBLE WALL SOCEET.

American Street Railway Association.

Appearances indicate that the Niagara meeting of the American Street Railway association in October will have a most important auxiliary in its exhibition of generating and operating machinery and the many devices used in street railway construction work. Secretary Penington announces that at least two-thirds of the available space for exhibition purposes has already been applied for. No assignments have been made, and it is believed there will be little choice in location, as members desiring to attend the meetings will find it necessary to pass through the exhibition hall in order to gain access to the meeting room.

Chicago Storage Battery Road to be Reorganized.

A decree of sale was entered on Tuesday, July 27th, by Judge Showalter at Chicago, directing United States Master in Chancery Bishop to sell the effects of the Englewood & Chicago Electric Street Railway company. This step was necessary preparatory to the reorganization of the company. The decree shows that $1,178,000 worth of bonds were issued and are outstanding. Of this amount $278,000, including the so-called William V. Jacobs $150,000 worth, is being contested by the receiver. Levy Mayer, counsel for the receiver, insisted that the decree of foreclosure should be entered and that the property should be sold, notwithstanding that the validity of all the bonds had not yet been adjudicated. The decree provides that out of the purchase price there shall first be paid the costs of administration and then series "A" and "B" of receiver's certificates, amounting to $320,000, and thereafter the bonds. Plans for the reorganization of the company have already been agreed upon.

Metropolitan Electric Company's Financial Difficulties.

Judgments aggregating $34,773 were confessed by the Metropolitan Electric company of Chicago in the Superior Court on July 27th, and the property of the concern at 188 Fifth avenue was immediately levied upon. One of the judgments was for $27,723 in favor of William H. McKinlock, president of the company, and the other was for $7,050, in favor of the American Exchange National Bank. The officers of the company assert that the liabilities of the concern outside of the claims represented by the judgments are very small.

The Metropolitan company was formed several years ago by William H. McKinlock and Walter C.

McKinlock, both of whom had had considerable experience in the electrical supply business. The company secured a good line of specialties and engaged extensively in general supply business. The cause of the company's financial difficulties is said to be slow collections.

Rate War between Chicago Lighting Companies.

In spite of the fact that Chicago is generally associated with the idea of municipal ownership in the consideration of all questions of public lighting, it is a fact that the city depends upon central station companies for considerable current to operate street lights, particularly in the southern part of the city. Two of the companies, the People's Electric Light and Power company and the Hyde Park Electric Light and Power company, have been engaged in a spirited rate-cutting war for some time, and wherever the lines of both companies were to be found the people secured their service at a very small cost. The city comptroller, becoming cognizant of this fact, determined to secure some advantage for the city, and he has accordingly asked both companies to bid upon the city lighting for the district which they occupy. It is possible that this may bring the companies to their senses and be the means of effecting a working agreement.

Telegraphic Communication with the Klondike.

Arrangements have already been made for establishing telegraph communication with the Klondike. Articles of incorporation of the Alaska Telegraph and Telephone company were filed at San Francisco on July 23d by local capitalists, who propose to run a telegraph line from Juneau to Dawson City over the trail by way of Chilcoot Pass and down along the shore of lakes and rivers. No poles will be used. Both telegraph and telephone wires will be laid inside of a big cable, which will rest on the surface of the ground. Of course, during the greater part of the year it will be covered by snow. The method of covering the cable will be the same as that employed with ocean cable. From Dawson branches will be built to Circle City and Forty Mile. Agents will be established every 50 miles, to provide for messages along the route and to make careful daily inspections of the cable.

Alley "L" Electrical Equipment.

Reports from Schenectady are to the effect that the tests of the six-car train of cars of the South Side Elevated Railway company of Chicago have been successful. The cars have been equipped with electric motors and controllers at the works of the General Electric company, and with contacts and connections for operation by the third-rail system. The novel feature is the Sprague system of motor control, by which, although each car is equipped as an independent unit, all the motors of the train can be controlled from one point when the six cars or any number of them are coupled together. Officers of the company, A. D. Lundy of Sargent & Lundy, consulting engineers, and others, witnessed the trials, on which depend the acceptance of the Sprague system. A correspondent says: "The test took place on a track 7,000 feet long, built for that purpose, and was under the personal supervision of Frank J. Sprague, the inventor of the system. The cars used were those that run on the South Side road, and were sent here several weeks ago to be equipped. There were six of them, and they were run singly and in bunches of two, three, four, five and six. The speed register at times indicated 35 miles an hour, though the roadbed was new, and the rails slippery from a heavy rain. The test was satisfactory, and the Chicago men were much pleased."

The contact rails for the new electrical equipment of the Alley "L" have been distributed over the structure, and the work on the power house foundations will be begun in a few days.

Excursion over the Storage Battery Road.

The Y. M. C. A. Electrical club has planned an excursion over the Englewood & Chicago electric railroad for Saturday, August 7th, to which it invites those interested in inspecting the new storage battery road. The club will meet in the association parlors at two p. m., and will be met at the South Park station of the Alley "L" at three o'clock by a special car, which will carry the party over the 14 miles of road and will be side-tracked at the power house, where every facility will be furnished for the inspection of the method of charging the batteries.

CORRESPONDENCE.

New York Notes.

New York, July 27.—It is stated that the commissioner of public works has decided to grant a permit to the Metropolitan Street Railway company to open the street to change the motive power of the Fourth avenue surface road from horses to electricity. At his request the company has filed a map in the Public Works Department showing just how the road will be built along Park row, under the changed motive power, from Center street to the terminus at Broadway. There was another hearing in Gen. Collis' office on Friday morning on the application. The plan showed the Metropolitan's intention so to change the Third Avenue company's cable conduit on the down track now used jointly by the two lines of cars as to make it into a double conduit for cable power and electricity. The Third Avenue company opposed the plan on the ground that the only right which the Metropolitan had on the down cable track was under a contract which permitted it to use the track as at present, or for the operation of cable cars, and that, by the Metropolitan's own showing in previous contested cases, the operation of a cable and an underground electric line on the same tracks was impossible. Henry A. Robinson, for the Metropolitan company, said that that company had never contended that it was impossible to run cars by cable and underground electricity on one track. His company proposed doing it in Twenty-third street, and had built the conduit with that in view, he said, but he acknowledged that it had not yet been done, and that there were not two slots at present. He admitted that the Metropolitan company claimed to own two tracks down to the postoffice. The company rested its rights in the original ownership and the agreement with the Third Avenue company. Gen. Collis said that if the Metropolitan company had a clear right to use the tracks, he should not bother himself much with the question of the physical possibility of construction.

The Vandepoele decision has excited much attention, and its importance is generally recognized. It is generally thought that the decision is final.

Rumors of street railway consolidation in this city and Brooklyn have been rife for a few days, but there seems to be little foundation for the big schemes proposed. However, the plan for the consolidation of the Brooklyn City and Newtown or De Kalb avenue road with the Coney Island and Brooklyn road has been announced. M. S.

TRADE NEWS.

At the regular quarterly meeting of the board of directors of the Davis & Egan Machine Tool company, Cincinnati, Ohio, on July 24th, a dividend of three per cent. was declared to all stockholders of record. This was the ending of the company's fiscal year, and it reports having done a profitable business during the last 12 months, fully 75 per cent. of which was export.

John T. Caulfield of Richmond, Ind., makes this announcement: "I have transferred to the Fulton Steam Boiler Works of Richmond, Ind., a company incorporated under the laws of this state, all the real estate, buildings, merchandise, machinery, patterns, tools and devices used by me in the steam boiler works and foundry business, heretofore known as the Fulton Steam Boiler Works and Foundry of Richmond, Ind., together with all uncompleted contracts, accounts due me and notes and bills receivable. The Fulton Steam Boiler Works, which has a capital stock of $85,000, receives all the assets connected with the business and assumes all my business liabilities." Mr. Caulfield is president of the company, and it is said that there will be no change in the working management.

The Standard Underground Cable company of Pittsburg gives the following guaranty to its customers: "Our attention has been called to the somewhat extravagant pretensions put out by interested parties, wherein claim is made, in substance or effect, of an exclusive patented monopoly of paper insulated electric cables and wires. We have been manufacturing and selling wires and cables of that kind for many years, and, under advice of counsel, we have no doubt whatever as to our right to do so. We therefore advise you that as regards any such wires and cables which you may purchase from us, we will be prepared at any and all times, at our own charge and expense, to defend any suit or suits brought against you for infringement of the patent referred to, we to be promptly notified of such suit, or suits, and to be allowed an opportunity to make defense therein."

BUSINESS.

The well-known firm of James Leffel & Co., Springfield, Ohio, has issued a neat new pamphlet, "D," replete with numerous illustrations and descriptions of the throttling and automatic engines, with portable and stationary boilers, which it is building in a variety of sizes and styles. A copy will be sent free to those interested, on application to the company.

Niagara Falls is truly a great source of electrical supply, but so is the Western Electric company, and therefore when one receives a dainty picture of the great cataract from the company named, with the words under it, "A Great Source of Supply," the connection is evident. The pretty picture is presented on cardboard, supplied with a cord for hanging up, and it is well worth having.

The electrical house goods department in the electrical supply business has been more or less neglected, perhaps, during the last few years, owing, largely, to the prominence taken by the electric light and power department of the same business. The Electric Appliance company prides itself upon the fact that the electrical house goods department of its business has always had good attention, and particularly during the last six or 12 months. The house goods department in its new general catalogue is to be exceedingly complete, and the Electric Appliance company claims that it will list the most complete line of house goods ever put before the public.

The Electric Arc Light company reports a largely increasing business. It is receiving large orders with every mail for Pioneer long-hour inclosed arc lamps and has been compelled to add to its already large force in order to meet the demands. One of the largest of the numerous contracts that have been taken by this company is that from Abraham & Strauss, retail dry goods merchants of Brooklyn, N. Y., who are equipping their new establishment with Pioneer lamps. This building is an addition to their already large quarters, and as soon as this installation is completed the entire establishment will be equipped with Pioneer lamps. This is said to be one of the largest contracts ever given for arc lamps.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued July 20, 1897.

586,539. Telephone Attachment. William W. Beck, Sebastopol, Cal. Application filed March 5, 1897.

This device consists of a bracket having two forwardly and inwardly projecting spring-metal clamping walls forming a narrow opening at the front, a plate or arm provided with a short slot, a screw-bolt projecting through the slot and clamping walls and serving as a combined pivot and adjusting device, and a second arm provided with a clip adapted to receive and hold the telephone receiver and adjustably connected with the arm first named.

586,543. Connection for Electric Switches. Herbert A. Bullard, Pittsfield, Mass. Application filed May 5, 1897.

A block having a tapered opening in one side, a recess in the opposite side, a nut carried in the recess, an annular groove around the nut, pins carried by the block and projecting into the annular groove in the nut, a tapered plug screw-threaded at its extremity to correspond with the screw-thread of the nut.

586,554. Flexible Insulated Conductor. John H. Kelman, Pittsfield, Mass. Application filed November 27, 1896.

This conductor consists of an extended length of tioned copper coated with linseed oil varnish.

586,556. Trolley Guard. James M. Kirker, Louisville, Ky. Application filed August 28, 1895.

A trolley harp has on each side of the sheave on the same spindle an eccentric wheel adapted to hang when at rest with its longest diameter downward, and to be revolved by the line-wire falling on its rim, having a flat rim with a raised outer edge at its shortest diameter, gradually changing to a beveled edge at its longest diameter.

586,559. Electrical Meter. William D. Marks, Philadelphia, Pa. Application filed January 23, 1897.

In combination with the actuating coils and the movable member means are provided for eliminating or reducing magnetic lag.

586,560. Electric Meter. William D. Marks and George R. Green, Philadelphia, Pa. Application filed May 29, 1897.

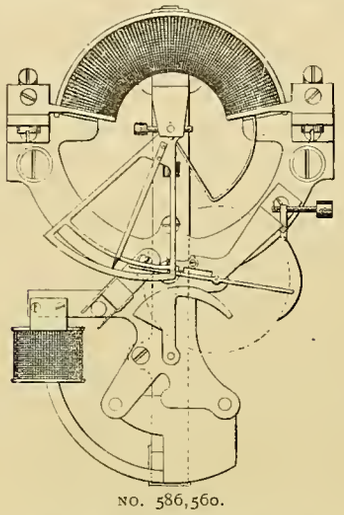
An oscillating motor is employed, together with a brake carried by a stationary support and engaging periodically with a movable member of the motor.

586,565. Fusible Cut-out. Charles G. Perkins and John Tregoning, Hartford, Conn. Application filed December 15, 1896.

A base of insulating material has contacts adapted to be connected with the circuit wires, the contacts have outwardly projecting fastening-heads and wedge-surfaces that incline toward the plane of the fastening-heads as they extend away from the fastening-heads, and a cap of insulating material bears forked spring-arms arranged so as to engage the inner edges of the fasteoing-heads and the wedge-surfaces, which, as the cap is attached to the base, bend the spring-arms out of their normal form and wedge them into locking curves back of the fastening-heads.

586,575. Lightning Arrester for Switchboards. Arthur M. Taylor, Niles, Mich. Application filed March 8, 1897.

In a pivoted eccentric contact bar, the jack springs and contact plates are arranged transversely to the base-board, a spring-actuated rod is connected to the bar, an electro-magnet has a coil connected respectively to the ground and to a fusible wire secured to the contact plate of the bar, and a latch connects the armature of the electro-magnet with the rod.



NO. 586,560.

586,578. Electrically Operated Railway Barrier. Christiaem C. Van Der Valk, Haarlem, Netherlands. Application filed September 10, 1896.

There is a main or working circuit, and an auxiliary circuit operated by a railway train controls the main circuit and preliminarily operates a warning signal.

586,602. Conduit Electric Railway. William E. M. Jackson, Indianapolis, Ind. Application filed October 5, 1894.

The system embraces a slotted conduit, accessible insulating supports situated at intervals in chambers, each support comprising an open spiral non-conductive, a containing-cup and its cover, a standard and a locking device to hold the parts in normal position, combined with a trolley wire, car and track equipment, and with suitable trolley apparatus.

586,606. Circuit Controller for Electric Vehicles. Karsten Knudsen, Chicago, Ill. Application filed October 21, 1896.

A contact finger for circuit controllers comprising two parallel members carrying at the ends inwardly projecting contact faces extending throughout a portion only of the length of the member, whereby a contact arm may be passed between the resilient members to make and break contact with the projecting contact faces.

586,615. Electric Heater. James F. McElroy, Albany, N. Y. Application filed August 14, 1895.

A supporting frame carries at its upper and lower edges insulating blocks or saddles; a continuous coil is arranged in zigzag fashion about the insulating blocks in such manner that the coils converge from top to bottom and bottom to top respectively.

586,622. Induction Coil for Medical Apparatus. Henry C. Porter, Chicago, Ill. Application filed January 26, 1895. Renewed January 18, 1897.

Current regulators are included in circuit with the source of generation, and each arranged in a circuit independent of the other, together with an induction coil included in circuit with one of the current regulators and independent of the other current regulator, whereby in one and the same apparatus either a high-tension or low-tension current may be interchangeably employed and each regulated as desired; a contact-breaker is provided for the induction coil, together with means for varying the rapidity of vibrations of the contact-breaker, consisting of a sliding member and a manually operated adjusting rod for the sliding member.

586,627. Active Material for Secondary Battery Plates. Sigmund A. Rosenthal, London, England. Application filed October 15, 1896.

This material is composed of oxide of lead, a rubber binding material soluble in the usual acid exciting agent and sulphate of ammonium.

586,647. Trolley. William Willett, Johnstown, Pa. Application filed March 22, 1897.

The harp is hinged to the upper end of the pole, and has a movement at right angles to the movement of the pole, and trolley wheels are arranged at obtuse angles to the pole, and adapted to embrace and ride upon the upper side of the conducting or trolley wire.

586,652. Apparatus for Working Electric Tramways. Chris Anderson, Leeds, England. Application filed Febuary 13, 1895. Patented in England July 13, 1894.

In an electric tramway system, the combination with a car carrying an electric motor, a contact-brush, a ramp, a switchboard, electrical connections from the switchboard to the contact-brush, motor and ramp, and a gripper, and with an electric supply conductor, a peg for making electric connection between the conductor and the contact-brush, and a haulage cable for use as an auxiliary power actuated by an electric motor, of a haulage motor cable or conductor for the motor, and a peg for making connection between the conductor and the ramp

586,685. Telephone Switchboard. Hammond V. Hayes, Cambridge, Mass. Application filed January 29, 1897.

The claim is given: In a telephone switchboard, the combination with a subscriber's line centering thereat, including the subscriber's line-signal mechanism, of first a registering mechanism of two movements, second an electrical mechanism, the operation of which causes or permits the first movement of said registering mechanism to be taken, while its own operation for such purpose is caused by the operation of the subscriber's line-signal mechanism; and, third, an electrical mechanism, the operation of which causes or permits the second movement of said registering mechanism to be taken, while its own operation for such purpose is caused by the completion of the operator's answering circuit, the two said electrical mechanisms being also so associated that not only the effective operation of the second cannot take place without the previous operation of the first, but the operation of the second prevents further operation of the first.

586,686. Electric Furnace. Robert F. S. Heath, Camden, N. J. Application filed February 24, 1896.

This furnace employs depending stationary carbons, a carbon carrier, a screw-rod for raising and lowering the carbons, a bearing for the screw-rod, a rotary melting pot, a material feeder, and means for removing the carbide of calcium from the melting pot.

586,687. Electric Furnace. Robert F. S. Heath, Camden, N. J. Application filed February 21, 1896. Renewed April 1, 1897.

Provision is made for rotating the carboo-carrying shaft; a slotted arm or carboo carrier is adjustably fixed on the shaft; a carbon holder is adjustably fixed to the slot of the carbon carrier, and carbons depend from the carbon holder.

586,700. Electric Line Insulator. John J. Tracy, Hartford, Conn. Application filed May 27, 1897.

An insulator having a base adapted to be secured to a support that is liable to move, and a bracket with an insulating wire-holding part movably connected with the base, and adapted to be held stationary by the wire that is connected with it when the base moves with its support.

586,702. Electrically Actuated Switch Mechanism. Walram S. Browne, Brooklyn, N. Y. Application filed November 25, 1896.

This device consists of a bar shaped on its lower edge to correspond to the trolley-wire section, means for attaching the trolley wire thereto, a longitudinal recess in one side of the bar extending to and including the central line of the bottom edge, and a plate therein, but insulated therefrom, and adapted to be connected by the trolley wheel.

586,723. Excessive Current Recorder. James R. Cravath, Chicago, Ill. Application filed February 5, 1897.

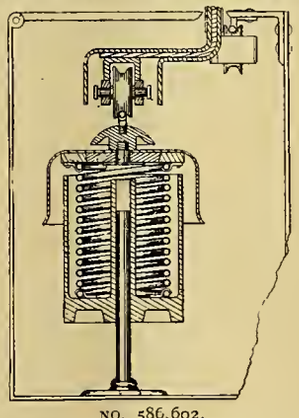
The first claim is for the combination with a thin sheet of fusible metal of a heating conductor extending transversely thereto and heated by an electric current to cause the conductor to melt its way through the sheet of fusible metal.

586,729. Method of and Apparatus for Effecting Electrolysis. Carl Kellner, Vienna, Austria-Hungary. Application filed February 24, 1896. Patented in France December 15, 1894; in Belgium December 15, 1894; in Italy December 31, 1894; in Austria January 17, 1895; in Hungary February 28, 1895; in Switzerland July 4, 1895, and in Norway July 16, 1895.

An electrolytic apparatus comprising two compartments, a fixed anode in one of them, a mercury cathode, and means for causing the cathode to uninterruptedly flow from a higher to a lower lever alternately and repeatedly from one compartment to the other before reaching such lower level.

586,755. Telegraph Cable. James M. Barr, London, England. Application filed December 26, 1896.

In a telegraph apparatus there is the combination of a pair of parallel adjacent conductors connected at one end to a common return, a source of current having one pole connected to the common return, contacts connected to the conductors at the transmitting end, and a key connected to the other pole of the source between the contacts.



NO. 586,602.

586,793. Telephone Attachment. Stephen C. Houghton, San Francisco, Cal. Application filed June 15, 1897.

One claim is for a transmitter, a receiver, a receiver-supporting arm movably supported, a projection carried by the arm and contact springs on each side of the projection.

586,809. Trolley Pole. Chauncey N. Dutton, New York, N. Y. Application filed July 27, 1896.

The device is a tubular trolley pole with a truss-frame fixed thereon, truss wires or rods connected to the truss-frame and to the body of the trolley pole, and adjustable struts connected to the body and to the truss-wires.

586,811. Electrical Conductor. Chauncey N. Dutton, New York, N. Y. Application filed July 27, 1896.

A multiple wired electrical conductor, having its wires woven around a forked support, is described.

586,813. Electrical Gas Alarm. John Erikson, Providence, R. I. Application filed April 3, 1897.

The principal feature of this gas-escaping alarm is the combination with a burner and a stop-cock, of a loop of wire having one leg held stationary and the other leg left free to break or make an electrical circuit by heating or cooling one of the legs, with means operated by the stop-cock to close the circuit when the gas is turned on, and break it when the gas is completely turned off, and wires to form the electrical circuit.

586,823. Electro-magnetic Motor. Francis J. Patten, New York, N. Y. Application filed December 4, 1896.

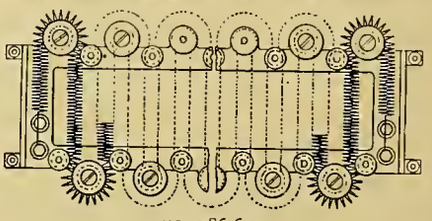
In a rotary field electric motor a fixed-ring field magnet is energized by multiphase alternating currents provided with an internally eccentrically pivoted armature of magnetizable material tangentially in contact with the ring field magnet internally at one pole thereof, and adapted to follow the rotating magnetic field by rolling around the inside periphery of the ring.

586,824. Electric Furnace. Francis J. Patten, New York, N. Y. Application filed January 30, 1897.

Two or more terminal electrodes are connected with each other by a carbon pencil of relatively small cross-section inclosed in a rotating magnetic field, the lines of force of which are substantially transverse to the pencil, together with means for establishing a rotating magnetic field around the pencil.

586,825. Electric Motor. Frank A. Perret, Brooklyn, N. Y. Application filed March 27, 1897.

The combination is claimed with a ring armature and commutator ring, of a field magnet within the armature, and a brush-ring mounted directly upon the field magnet.



NO. 586,615.

586,845. Electro-magneitc Third-rail System. William Grunow, Jr., Bridgeport, Conn. Application filed August 26, 1896.

An electrical contact system, consisting of a free or independent reciprocating electro-magnetic contact operated by the alternate action of a separate electro-magnet and gravitation.

586,852. Underground System for Electric Railways. Alvaro S. Krotz, Springfield, Ohio, and William P. Allen, Chicago, Ill. Application filed February 12, 1897.

A subway having the supporting yokes with the overhanging portions reinforced by webs or ribs which extend inwardly and upwardly from the sides of the yokes, is described, in combination with an insulator having a cap with lugs or sleeves adapted to fit within the ribs, and removable pins extending through the ribs and sleeves.

586,861. Electrically Operated Valve. Frank McDonald, Portland, Me. Application filed April 22, 1897.

A mechanism for controlling the flow of water through a fire-hose comprises a valve, a source of electricity, a motor in the source of electricity, a reversing switch in the source of electricity, a broad gear-wheel on the armature shaft of the motor, and a gear-wheel on a longitudinally movable screw-threaded stem of the valve and engaging with the broad gear-wheel.

586,864. Rheostat. Oscar H. Pieper and Alphonse F. Pieper, Rochester, N. Y. Application filed March 23, 1897.

A series of conducting contact plates insulated from the support, and having apertures through which the support passes, a continuous insulated wire wound upon the support between the plates of the series and electrically connected to the plates at the points of crossing from one space to the next, and a contact-arm co-operating with the exposed edges of the plates.

586,888. Telephone Signaling Relay and Circuit. Arthur S. Williams, Newton, Mass. Application filed May 20, 1897.

An electro-magnetic relay, comprising an electro-magnet with a central iron core, an iron casing, an interposed exciting helix, an associated maintaining helix, a tilting disk armature resting on its edge in front of the core, and two circuit-closers actuated by the armature, one controlling the continuity of the maintaining helix and the other adapted to control an independent local circuit.

586,891. Electrical Signaling Apparatus. Andrew A. Andersen, Altoona, Pa. Application filed February 14, 1896.

The arrangement comprises a receiver, comprising two electro-magnets, a pivoted lever carrying an armature and a verge, and an escape-wheel actuated by the verge to operate a pointer, the verge having one of its pallets rigid and the other pivoted, an adjustable stud, a link connected with the movable pallet, and a screw eccentrically mounted on the stud and serving to hold the link in place thereon.

586,894. Electro-depositing Device. John Bossard, Dubuque, Iowa. Application filed May 31, 1895.

A tank is provided with anode connection, a circular carrier having cathode connections from which a number of articles to be deposited upon are suspended within the bath, and means for causing the carrier to rotate in a horizontal plane, carrying the articles to be deposited upon around in the bath.

586,920. Electric Railway System. Harlan P. Wellman, Ashland, Ky. Application filed December 12, 1896.

A switch having an electro-magnet, a pivotally mounted armature, opposite lugs carried by the armature connected in series, and spring contact-arms connected in separate series and designed when contacting with the lugs to close a circuit.

586,933. Electric Switch. James F. McElroy, Albany, N. Y. Application filed January 9, 1896.

The combination includes a snap-switch for opening the circuit, with an adjusting switch, consisting of terminal blocks fixedly arranged around a vertical post, conducting pieces for varying the connection attached to a carrier which rotates on the vertical post, means for connecting the carrier to the electric switch, whereby the electric switch locks the adjusting switch when the electric switch is closed and unlocks it when open.

Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, AUGUST 7, 1897. No. 6

Englewood and Chicago Electric Storage Battery Road.

By George A. Damon.

There is probably no electric railroad in the world which is attracting more attention than Chicago's new storage battery road now successfully operating 20 motor cars regularly in the southern part of the city. This road is the first one in this country to have an equipment specially designed throughout for the use of this ideal system of electric traction, and as it has been constructed and is now being operated under most favorable conditions, the result of the experience here obtained will be of lasting benefit to those interested in the development of the storage battery system of propulsion.

The consolidation of the storage battery interests a few years ago removed the danger of patent litigation, and the lessons taught by the unfortunate experiences of earlier attempts in this line had their effect. High-class engineering talent was retained and every advantage that could be obtained from an economical power plant, operating on a steady load, was secured. The roadbed and track were specially designed for the unusual conditions of traffic, and every detail of construction and operation has been carefully considered. As a result, therefore, the installation of the Englewood and Chicago road deserves to be considered as a demonstration of what storage batteries can do, rather than be termed an experiment. In comparison, all former attempts at storage-battery traction appear crude.

The history of the Englewood and Chicago railroad, under its present management, dates back to 1895, when the company came into possession of valuable franchises, providing for a right of way between Woodlawn and Harvey, with numerous branches, covering in all about 35 miles of streets. The company carefully investigated all the existing systems of electric traction and decided in favor of storage batteries. G. Herbert Condict, who was then in charge of the battery cars operated on Fourth and Madison avenues, New York, was early given entire charge of the work of planning and constructing the new road, with instructions to make the equipment as complete as the state of the art permitted. In consultation with J. H. Vail of Philadelphia, and later with B. J. Arnold of Chicago, who is the consulting engineer of the company, the plans were perfected which resulted in the present economical arrangement of the plant, and the unique equipment for handling the batteries. Hugh Hazleton was Mr. Condict's assistant, in active charge of the work at the power house, and H. B. Quick was superintendent of track construction.

The power house was completed last spring, and on June 20th 10 cars were put upon the road. From December last and all during the winter and spring two cars were kept in service, the batteries being charged from a temporary plant. At the present time nearly 20 motor cars are making regular trips, and giving satisfactory service. The large crowds which have patronized the road since its opening have led its superintendent, A. R. Davies, to secure a number of trailers, but occasionally even this equipment is found insufficient to accommodate the patrons of the road.

The route of the road is shown in the map on page 75, in which the full lines show the road already in operation, while the dotted lines indicate the proposed extensions. It will be seen that the road connects with the Alley "L" at the South Park avenue station on Sixty-third street, in Woodlawn. A picture of one of the battery cars in front of the neat waiting room at the foot of the stairway leading from the elevated structure is shown on page 75. The road offers easy access to Oakwoods cemetery, touches Auburn Park, and runs south on Vincennes road, through South Englewood and Washington Heights, where it crosses the city limits and penetrates Blue Island, the present southern terminus. Eventually the line will extend to Harvey. On Morgan avenue a spur line runs west through the beautiful little village of Morgan Park, terminating at Mt. Olivet and Mt. Greenwood cemeteries. At present more than 23 miles of track are laid, of which 19 miles are double track and four miles single track.

Just at present the road is operating two sets of cars, one running between Sixty-third street and Morgan Park, under a 16 minute headway, and the other with cars 22 minutes apart, connecting the terminus at Seventy-ninth street and Halsted with Morgan Park. The line runs through a pleasant district and has already become popular for excursions, picnics and storage battery evening parties.

Battery Charging Room Showing Trays.
Transfer Carriage with Battery Tray.

Rolling Battery Tray on Transfer Carriage.
Raising Battery Tray under Car.

ENGLEWOOD AND CHICAGO ELECTRIC STORAGE BATTERY ROAD.

It can easily be reached from the city, as it makes connections with the Halsted street, the Wentworth avenue and the Cottage Grove avenue cars of the Chicago City railway, as well as with the Alley "L." The lines of the Calumet Electric railway cross it in a number of places.

Realizing that much depended upon a smooth roadbed, which would prevent jolting of the batteries, careful attention was given to the track construction, with the result that it may be compared to the highest class steam road practice. Oak ties eight feet long, spaced two feet center to center, rest upon six inches of gravel ballast. Eighty pound seven inch Johnson girder rails, resting on braced tie plates, are used throughout, joined with six bolt fish-plates and kept from spreading by tie-rods at every joint. The track, of course, is not bonded and the entire absence of overhead construction gives a very neat appearance, which is especially noticeable where the battery road connects with or parallels the trolley lines.

The power house, also shown on page 75, is located at Eighty-eighth street and Vincennes avenue. The cost of the road is not affected by the location of the power plant, as in the case of a trolley line operated by means of a feeder system, and in this instance a site for the plant was selected which was convenient to a steam railroad and where real estate was cheap. The power plant is 5½ miles from the Alley "L" terminus and is one block from the South Englewood station of the Chicago, Rock Island and Pacific railroad. The power building is of brick and stone, with a pitch and gravel roof, and consists of two parts, the car barn and the power house proper which comprises the boiler and engine rooms. The plan of the car barn and power house is presented on page 74, which also shows the arrangement of tracks for the handlng of the cars. Extending across the front of the car barn and upon the second floor are the offices, comprising a large general and private office, a reading-room for conductors and motormen, a room for lockers and a toilet room, equipped with shower baths. Under the offices an arcade is formed in which the cars stand while changing batteries. The car barn at present has a capacity of 24 cars and when extended will accommodate 50. In fact, the entire equipment of the road has been planned with the ultimate object of operating a 50 car system. An electric transfer table runs through the center of the building, taking the cars from the tracks under the arcade and delivering them to the car barn tracks.

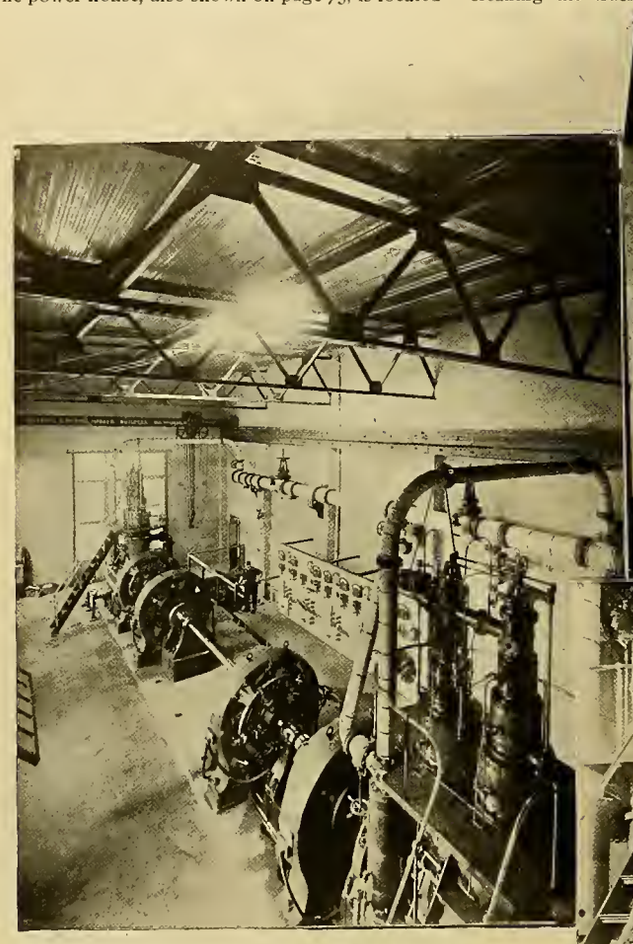
The basement under the car barn is the most interesting part of the entire plant. Here the storage batteries are charged. Several views of this part of the plant are presented on page 71. A cross-section of half of this basement shows the batteries arranged on both sides of a central alley, extending the length of the building. The center of the car in the barn comes directly over this alley.

The rolling stock consists at the present time of 16 open cars, 8 closed cars and 16 trailers, as well as a large 3,500 gallon sprinkler and a snow plow. The cars were built by the St. Louis Car company, and are mounted upon Dupont trucks. In appearance the cars resemble ordinary electric cars without trolley poles, and in this respect are a great improvement over the usual storage battery car, in which provision is made for storing the batteries under the car seats. In the truck, however, radical differences will be found. The method adopted for handling the batteries is to place them upon strong trays, which are supported upon the trucks beneath the car and between the axles. To leave this space free for the battery trays the 50 horse power Walker motor with which each truck is equipped is suspended on the outside of the car axle. The battery tray is supported on two bars running across the frame and engaging hooks formed by bending over four five-inch channels, which pass under the tray. The snow plow has provision for carrying three trays of batteries, one for each 50 horse power motor and one to operate the large broom for cleaning the tracks. With such an equipment the minimum amount of trouble will be experienced in keeping the tracks clean and the road in operation in the severest weather.

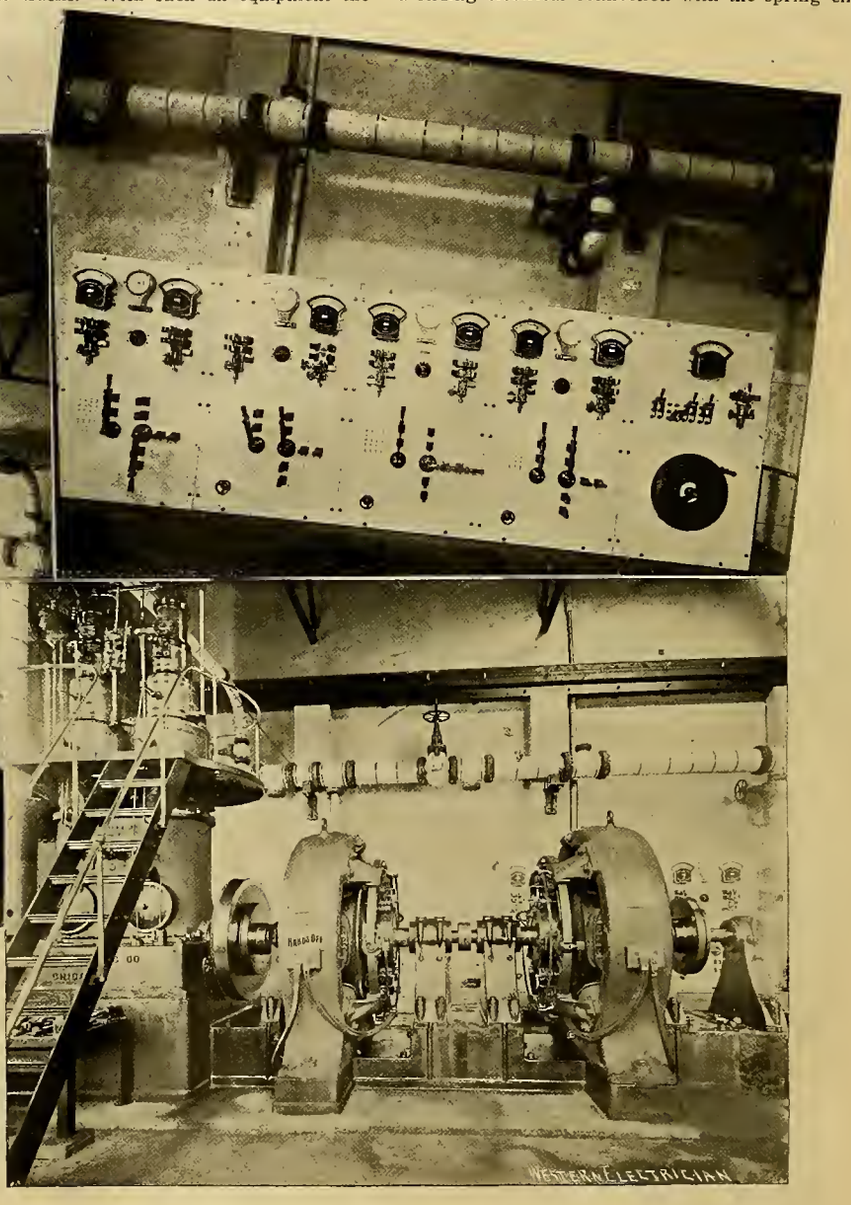
The method of handling the battery trays, however, presents the most unique features of the entire installation. The problem was to remove the discharged batteries at the end of each trip and replace them by a charged set with the least possible delay and with the minimum amount of labor. The ingenious device designed to do this was furnished by the Shaw Electric Crane company of Muskegon, Mich., and it enables the batteries to be changed in 1½ minutes. The entire work is done by one man. The elevator is part of a traveling carriage which runs along the track in the alley, extending down through the center of the charging room in the basement. This carriage is provided with two elevators—one at each end—while the middle is occupied by a platform for the attendant, from which he controls the operations. Each elevator is fitted with rollers worked by skew-bevel gearing upon which the battery trays are carried. The charging tables on each side of the transfer pit are also fitted with similar rollers and a clutch coupling is arranged so that the rolls on the elevators may be coupled to the rolls on the charging tables and the trays automatically shifted. There are two of these carriages, one in each charging room, though the present equipment requires but one. Each carriage is provided with five motors: one to operate each elevator, one for each set of rolls and one to run the carriage up and down the alley between the charging tables.

The process of replacing a battery tray upon the car may be described as follows: The car rounds up into the station from either direction, stopping under the arcade exactly over the pit at the end of the charging room. The attendant below raises an elevator and removes the discharged battery, it being released by the pulling of a lever. On lowering the elevator the entire carriage is advanced a few feet, bringing the charged battery directly under the car truck, to which it can be readily elevated, the hooks automatically engaging the cross-bars and the brass plates on the sides of the trays making a sliding electrical connection with the spring clips on the car trucks which are the terminals of the controller cables. The empty elevator is lowered and the car is ready to proceed upon its trip. The tray of discharged batteries, which has just been removed from the car, is conveyed by the carriage to an empty charging table, where it is rolled from the elevator, making automatically by means of the plates on its side an electrical contact with the charging circuit. The mechanism of this battery transfer carriage is made entirely interlocking, so that it is impossible to perform two operations at the same time, which would probably prove disastrous. Thus it is impossible to move the carriage until the elevator is lowered from under the car, and the trays cannot be rolled in either direction until the charging tables and the carriage tables are directly in line.

The elevators can also be used for placing a charged battery in the car while it stands on the car barn tracks, so that each car on leaving the house is ready for the road. The motors on the cars can also be removed with the aid of the elevators, thus facilitating repairs and inspections. The batteries on each car consist of 72 cells, each con-



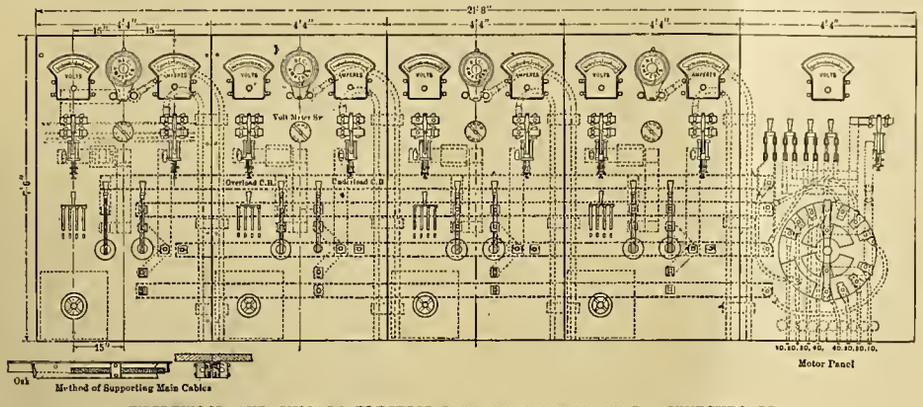
Engine Room from Visitors' Gallery.



Switchboard.
Engine and Generators.

ENGLEWOOD AND CHICAGO ELECTRIC STORAGE BATTERY ROAD.

taining nine plates—four positives and five negatives. The negative plates are all of the "Chloride" type, but part of the cars are equipped with the "Tudor" and part with "Manchester" positives. Each plate is 14⅞ inches long and 7¾ inches wide. The negative plates are one-fourth inch and the positive plates five-sixteenths inch thick. The outside dimensions of the hard rubber containing jar is 5¼ by 8½ by 17¾ inches deep. The weight of the elements of each cell is 75 pounds; of the jar five pounds and of the electrolyte, 20 pounds, making a total weight for each cell of 100 pounds.

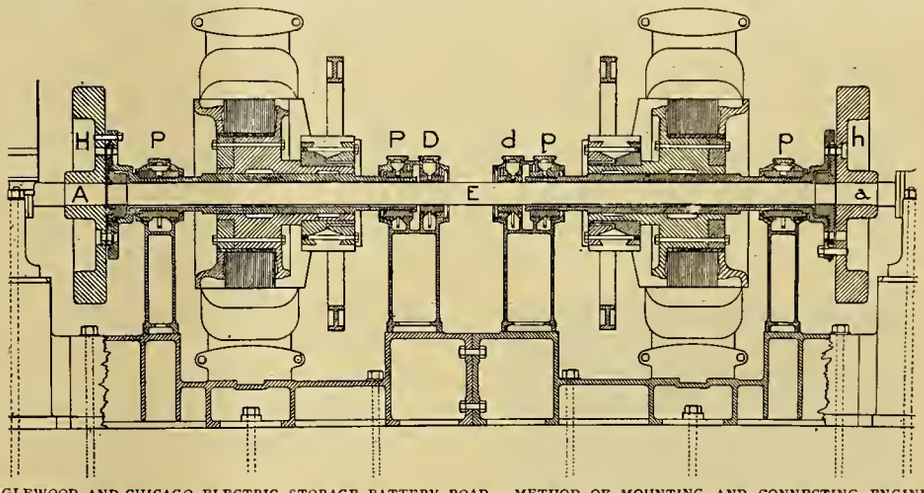


ENGLEWOOD AND CHICAGO ELECTRIC STORAGE BATTERY ROAD.—SWITCHBOARD.

Each tray contains 72 cells, arranged in 12 rows of six each. The battery plates are connected by means of lead strips electrically welded so as to make a solid joint, neither bolts nor screws of any kind being employed. The cells are connected in four separate groups of 18 cells, each group being connected by flexible cables to two large brass plates on the side of the trays. The entire weight of the tray of batteries is 7,800 pounds, which makes the extra weight of the car due to the storage cells about four tons. The top of the batteries are covered with a loose-fitting hard rubber crate which prevents the splashing of the acid out of the containing jars. The storage batteries, when in series, will deliver a current of 400 amperes at about 144 volts. They were specially designed for traction purposes, and were supplied by the Storage Battery company of Philadelphia. Those which have been in service more than six months, and have made over 6,000 miles, have yet to show any signs of deterioration. To make the round trip of nearly 24 miles takes a car about two hours, which is practically the time each battery is in service. They can be fully charged in 40 minutes, but will show a slightly better efficiency if the time of charging is longer. It will thus be seen that it is unnecessary to provide twice as many batteries as cars, as is usually supposed, as the road can he operated successfully with an equipment of battery sets only 50 per cent. greater than the number of cars on the line.

It is well known that as a battery becomes charged its electromotive force rises. If the charging voltage remains constant the current received by the battery diminishes in proportion as its electromotive force rises. Thus to charge a cell at a given rate requires a constantly increasing charging voltage. If the final voltage were to be applied to the battery at first in its discharged condition a great rush of current would result, which would be injurious to the plates. It is desirable, then, that the charging cells be subjected to a variation of voltage. To accomplish this without the use of boosters, resistances, or counter electromotive force cells, any of which methods would be uneconomical, the plan of operating three dynamos at three voltages was adopted and is working successfully. Three cables having a common negative return extend from the back of the switchboard along the cells on the charging tables. By means of plug switch the operator upon the transfer carriage can connect each tray of batteries at will to either cable. The discharged battery is first subjected to a potential of 160 volts, which results in a charging current of about 150 amperes. This current gradually becomes less until, when the attendant observes from the ammeter above the tray that it has reached 30 amperes, the battery is changed to the next higher potential, which is 172 volts. The charging current again reaches 150 amperes and similarly decreases, and finally the battery is connected to the highest potential of 176 volts, where it completes its charge and is ready for service.

The controllers were manufactured by the Walker company and are of special design for the service, as the low voltage and the large currents used require contacts of much larger surface than are ordinarily necessary. The controller has five points and allows the following combinations: (1) The four sets of batteries in parallel, giving about 36 volts; (2) batteries in series parallel in sets of two, giving about 72 volts; (3) batteries in series with resistance; (4) batteries in series without resistance; (5) the same, with the field of motor shunted.

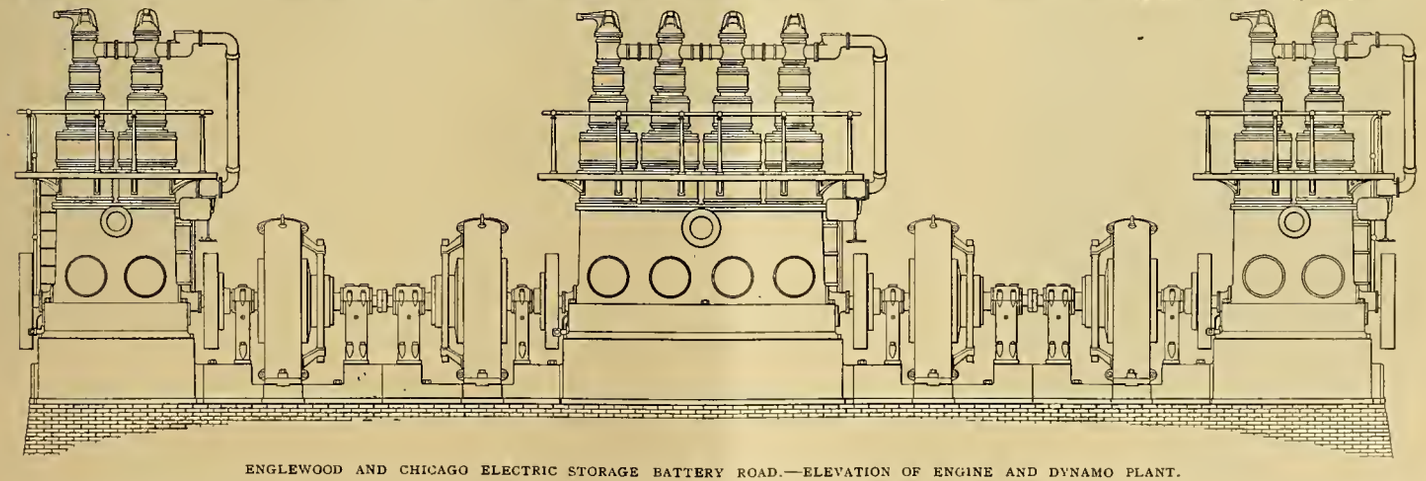


ENGLEWOOD AND CHICAGO ELECTRIC STORAGE BATTERY ROAD.—METHOD OF MOUNTING AND CONNECTING ENGINES.

In describing the power house a beginning will be made with the fuel and water and the several departments considered in order. Coal is delivered upon a siding immediately back of the boiler room, and can be shoveled from the cars directly upon a coal platform made of iron extending along the boiler room in front of the boilers. Without being lifted it can be conveniently passed into the hoppers of the Roney stokers with which the boiler grates are supplied. At present three Heine water-tube boilers are installed, but ultimately the boiler equipment will consist of six boilers of the same type, and provision has been made for them. The escaping gases pass through a smoke flue back and above the boilers to the stack, encountering on the way a Greene fuel economizer consisting of 192 pipes, by which their temperature is considerably reduced. A by-pass is provided for use when the economizer is not in operation. The stack is self-supporting and is constructed of steel, 150 feet high and 7 feet in diameter and was furnished by the Variety Iron Works of Cleveland. It rests upon a brickwork foundation, raising it an additional 22 feet above the ground. The brick smoke flue from the economizer enters this brick base.

The feed water is obtained from two independent sources—the city supply and an artesian well. Jet condensers in conjunction with a cooling tower are installed, so that the same water is used over and over, comparatively little additional supply being required to make up the waste due to evaporation. The pumps, condensers, and cooling tower are of the Worthington patterns. Duplicate pumps are provided, either of which can take the feed water from the city mains, the artesian well or the discharge pipe from the jet condenser. The water can be delivered through the heater which receives the exhaust steam from the auxiliary pumps and then through the economizer into the boiler, or either of these feed-water heaters can be cut out in case repairs are necessary and the water delivered directly to the boilers. The economizer utilizes the waste flue gases to heat the water up to boiler temperature ready to make steam. It also acts as a reservoir, containing a considerable supply of hot water at the evaporative point, and thus materially increases the duty of the boilers.

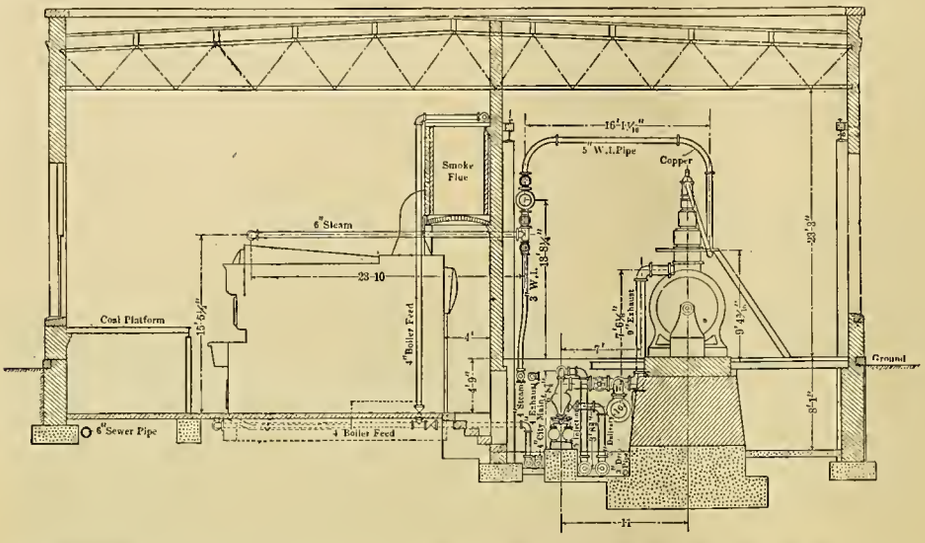
The live steam leaves the boiler through a six inch pipe and enters from the bottom a header supported on the walls of the engine room. From the top of the header a wrought iron bend is taken leading to each engine and terminating in a copper bend to provide for expansion. An auxiliary header is provided below the engine room floor for the live steam furnished to the boiler feed and air pumps. The exhaust from the engines is conducted to the jet condensers, where it mixes with the injection water, which is at a temperature of about 80 degrees as it comes from the well at the bottom of the cooling tower. The air pump of the condenser delivers the condensed steam and heated injection water to the top of the Worthington cooling tower. This tower is 30 feet high by 12 feet in diameter. Here by means of revolving pipes turned by the pressure of the escaping water itself, it is delivered in jets over the top of a collection of vitrified sewer tile laid up on end in tiers in such a manner that the water, trickling down over the pipes, is spread out over a large surface. A blast of air from a powerful blowing fan driven by an electric motor cools the air sufficiently so that, as it collects at the bottom of the tower, it can be used again as injection water. The feed-water tap in the condenser discharge is made before the pipe is led to the cooling tower. An auxiliary exhaust header is provided ending in an exhaust head



ENGLEWOOD AND CHICAGO ELECTRIC STORAGE BATTERY ROAD.—ELEVATION OF ENGINE AND DYNAMO PLANT.

and an automatic pressure valve to be used in case the condensers fail to work. An opening in the engine room floor allows an easy inspection of the exhaust and feed-water piping, the pumps and condensers in the basement. The engine room is upon the ground level and the head room allowed in the basement is about eight feet. A door leads out of the condenser pit into the boiler room.

In selecting the sizes of the generating units several considerations were kept in mind. It was necessary to have three dynamos operating at different voltages all the time, and it was desirable to have one



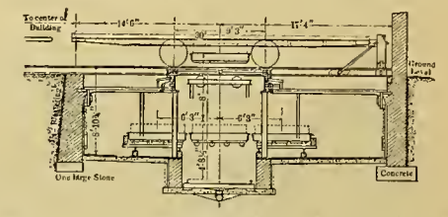
ENGLEWOOD AND CHICAGO ELECTRIC STORAGE BATTERY ROAD.—SECTION OF POWER STATION.

relay generator. This practically necessitated the installation of four dynamos. Provision was to be made for an ultimate output of twice that required at present, and it was decided to install at once generators of sufficient capacity to handle the future demands. To directly connect these four generators to independent engine units was considered expensive and uneconomical, while to belt the generators to counter shafting, it was thought, would require a large amount of floor space and would have been at best an unsightly and awkward plan, though it would have reduced the number of engines required to two and made a flexible arrangement. The plan finally adopted for connecting the engines and generators was that known as the Arnold system of power station construction. This arrangement furnished a very happy solution of the difficulty and resulted in a neat, compact, flexible and reliable generating plant. The plant as it will appear when completed will consist of four 190 kilowatt multipolar generators made by the Walker company and three upright tanden central valve Willans engines made by the Bullock Manufacturing company of Chicago, as shown on page 73. The two end engines develop 250 horse power each and the center engine, which is rated at 500 horse power, is similar in every respect to the end engines except that it has four instead of two sets of cylinders. The speed of each engine is regulated by a throttle valve in the live-steam pipe controlled by a centrifugal governor on the shaft. The cranks are set opposite each other and the steam acts on one side of the piston, resulting in a pressure in only one direction upon the crank-pins. The steam entering the high pressure cylinder from the steam chest, exhausts through the hollow piston rod into the receiver space below, ready to act on the following piston. An air cushion is provided which takes up the momentum of the moving parts and allows the high rotative speed of 380 revolutions per minute without noise or vibration.

The engines and dynamos are connected so that the center engine can operate any one or all of the four generators, while either of the smaller engines at the ends of the shaft can run either or both of the adjacent generators. Thus the center engine can operate the three dynamos required, leaving the two small engines and one dynamo idle, or the large engine can run any two generators and one of the end engines can operate the other dynamo necessary, still leaving a reserve of one engine and generator; or the large engine can be shut down and the plant still be operated economically. In fact the same flexibility and reliability has been secured as would have resulted from four independent direct-connected units, but by means of the Arnold system much floor space and the investment required for an additional engine have been saved. The entire plant of 1,000 horse power is contained in a space 56 feet long by 12 feet wide.

At the present time the large center engine is not installed, as will be seen in the picture on page 72, which represents the view of the engine room from the visitors' gallery. In its place a temporary shaft is erected carried on separate bearings, so that it is possible to operate any one or all four of the generators from either end engine resulting in an economical plant even under the unfavorable conditions of the small load now existing.

The illustration on page 72 shows two of the generators and part of one engine, and a cross section of the method of mounting and connecting the generators is shown on page 74. Here it will be seen that the generator armatures are mounted upon hollow steel shafts or quills resting in the independent bearings PP and pp. Through the center of this quill concentric with it but not in contact at any point, extends a solid over-



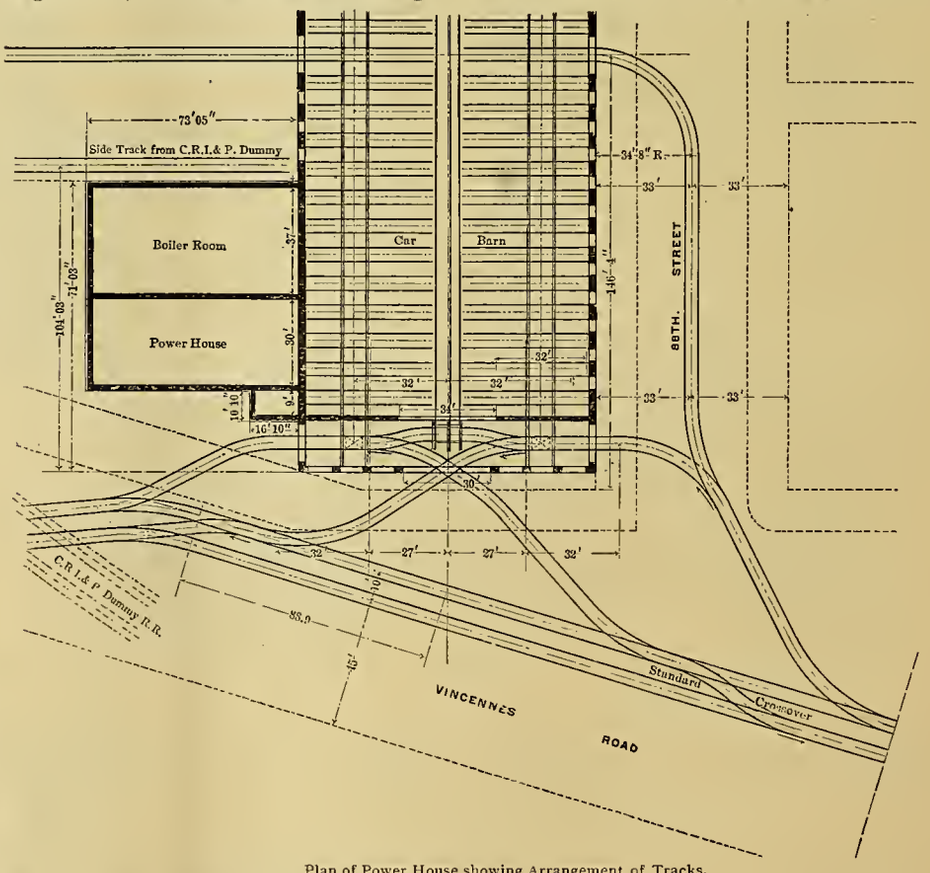
ENGLEWOOD AND CHICAGO ELECTRIC STORAGE BATTERY ROAD.—SECTION OF PIT.

hanging steel shaft E, supported also by independent bearings Dd. Suitable flanges and couplings are provided at the ends of the shaft and of the quills to connect with the engine flywheels Hh. It is the interior shaft that is peculiar to the Arnold system and gives to it its flexibility. Normally the shaft is idle and the system requires the movement of no more shafting than usual; but in case it is desired to operate a generator by an engine which is not contiguous to it, the shaft is brought into play and is connected to the engine shaft at one end and extending through the hollow quill is connected to the generator quill at the other end. In the present case the couplings are mechanical and the engines are stopped a short time when the changes are made. This, of course, introduces no serious inconvenience on account of the character of the load, but in a case where it is imperative to operate the generators continuously magnetic couplings are designed to go with the system, and by this means the generators can be shifted from one engine to another by the throw of a switch.

The switchboard is a handsome structure of five panels of two inch white marble, and is located at one side of the engine room. The connections are shown in the cut on page 73, while the appearance of the board in the station is set forth in the half-tone picture on page 72. It will be seen that one panel is provided for each generator and an additional panel contains the motor switches. Along the back of the board extend four heavy omnibus bars. The

Interior of Car Barn.

Cooling Tower and Base of Stack.

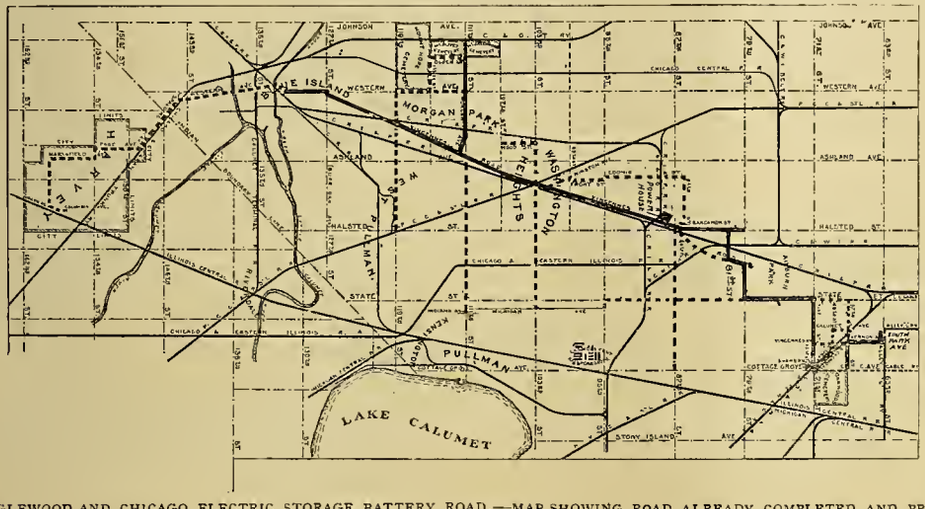


Plan of Power House showing Arrangement of Tracks.

ENGLEWOOD AND CHICAGO ELECTRIC STORAGE BATTERY ROAD.

upper bar is the common negative bar while the three lower bars are the high, medium and low voltage bus-bars respectively. Each generator panel is equipped with two separate single throw switches of sufficient size to handle the entire output of the dynamo. One switch connects the negative lead of the generator after it has passed through a recording ammeter and a circuit breaker to the common negative bus, while the other switch can be turned through an angle of 180 degrees and can connect the positive lead of the dynamo, which is also protected by a circuit breaker, to any one of the three bus-bars. In this way any generator can work on any bus-bar. Each generator panel is also equipped with a Weston illuminated dial ammeter and a voltmeter of the same pattern, while a rheostat for controlling the generator voltage is placed at the bottom. The motor panel controls the circuits running to the two battery transfer cars, the car transfer tables, the cooling tower and other motors in the building. The large circular switch in the middle of the panel is designed to connect the motor bus-bars at will to the high, medium or low omnibus bars on the back of the board or to any one of the four generators. This makes a very flexible arrangement and allows the motors to be operated by a set of car batteries when the generating plant is not in operation.

Some idea of the carefulness with which details of the business, as well as the engineering part of the power station construction, has been watched by General Manager Condict can be gained, when it is stated that the entire cost of the power plant, when completed, including boilers, stokers, stack, economizer, cooling tower, condensers, piping, crane, foundations, engines, generators, Arnold system, and switchboard, capable of delivering 1,000 mechanical horse power, will be only $86 per horse power. When it is considered that everything which has been put in the plant is of the very highest possible grade, resulting in a model power house, which,



ENGLEWOOD AND CHICAGO ELECTRIC STORAGE BATTERY ROAD.—MAP SHOWING ROAD ALREADY COMPLETED AND PROPOSED EXTENSIONS.

operating on a steady load, ought to produce a horse power-hour on less than two pounds of coal, these figures are surprisingly low.

The regular working force of the power house consists of a fireman, an engineer and a man to handle the batteries, and the shifts are eight hours each. The road is often operated at times when the power plant is not running, and the coal and labor items of the operating expenses promise to be comparatively small. The road has not been in operation long enough, however, to warrant the publication of any figures on the cost per car mile, but careful records are being kept, and preparations for elaborate tests are being made. It is promised that the results will be made public.

The one uncertain factor in the success of the enterprise is the life of the plates and the cost of repairs on the batteries. Everything else is certain, and is favorable to success. The roadbed is smooth, level and permanent, and the generating plant is the most economical that can be built. The battery shifting device is automatic and requires the minimum of labor and time. The three charging voltages contribute to an economy in charging the batteries, and the management of the road has been intrusted to experienced and capable men. Of the batteries it may be said that advantage has been taken of the experience gained elsewhere, and that the manufacturers have endeavored to produce a plate which will have long life.

Whatever the outcome, the fact remains that the road, as it now stands, is a unique and notable engineering accomplishment, and to the engineers who have had the work in charge, and especially to General Manager Condict, credit is due for the skill and ability which has been shown in its conception and construction.

Taken altogether the plant may be considered a model in design and construction, and the efficiency thus far obtained justifies the care and study that have been devoted to the problems involved. It is unquestionably the most complete installation of the kind in the world and is believed to be considerably in advance of foreign practice.

Union Pacific Telegraph System.

The Union Pacific Railroad company is preparing for the separation of its business from the Western Union Telegraph company and the establishment of an independent telegraph system. The origin of the demand for separate telegraph systems, after the two big companies had maintained one system with satisfactory results for a generation, is something of a mystery, but it is conceded generally to have been due to stockholders of both companies, who contended that each was securing advantages by the combination to the disadvantage of the other. Finally the litigation for separate maintenance was commenced, but in rather a covert manner, the government being the ostensible complainant, on the theory that its interests would be better conserved if the Union Pacific had an independent telegraph system. Both companies resisted the application, but not, as they alleged and as many railroad men think, because there was any particular advantage in the combination to either side, but because of the extraordinary difficulty of separating the multiplicity of interests involved which had accumulated through more than 30 years of constant service. The United States court ordered the two companies to separate their lines, but dilatory tactics were resorted to, and for several years the court's order was held up. Now General Superintendent Korty has gone out to begin the work of separation. Already he has begun the construction of a separate system leading from Salt Lake City up to Ogden, and from there the work will be pushed rapidly eastward.

Some idea of the gigantic project involved may be secured when it is remembered that in order to operate its great train service properly the Overland must have at least five through wires from one end to the other, three of which must be of the best copper and the other two of fairly good material. Still, the work of constructing the new line across rivers, deserts, and snow-capped mountains will be child's play in comparison with the difficulties attending an equitable distribution of the telegraph property now in use by the two companies. Originally the interests were quite distinct, but repairs were made repeatedly, new lines erected to accommodate the increasing traffic and a multiplicity of conflicting properties merged into the one system, continuing through a period regarded as the life of two complete systems of telegraph. At first the telegraph line was pushed out from day to day along with the construction of the railroad. At that time but one small iron wire was strung, though the cost was enormous. The work was done by the construction company having the contract to build the railroad, and the lien of the government was supposed to apply to this, as well as other property of the company on the main line. Future developments indicated that nothing of the kind was contemplated by the original owners, and to-day the telegraph lines will not go with the road. So if to-morrow the government should foreclose on the property it would have to buy the telegraph lines of the company or erect some of its own. Meantime the trains could not be operated on the road without the help of the telegraph system, so the old company controls the situation completely.

For several years after the completion of the road the corporation operated an independent telegraph line. At that time the great combination known as the Western Union was in its infancy, and the Union Pacific Telegraph company was only one of many small lines doing business throughout the country. Finally, as the Western Union continued to absorb other lines, the Union Pacific found itself exchanging business at Omaha with that monopoly wholly. Then the proposition was made by the Western Union to take possession of the Union Pacific's lines, do the Union Pacific's business free, pay the operators' salaries and keep the line in repair. In return for this the Western Union was to have the commercial business originating on the line, the exclusive privilege of transferring all business at this point and the practical control of Union Pacific telegraph lines for all purposes that did not conflict with the operation of the train service and other things appertaining to the business of the Union Pacific. At once the commercial offices of the two companies here were combined and the Union Pacific surrendered all control of its telegraph business. New lines of wire were necessary to transact the increasing business, and these were constructed by the Western Union. Old wires were destroyed and the Western Union put in new ones, and old instruments gave way before the later inventions, until to-day scarcely

ENGLEWOOD AND CHICAGO ELECTRIC STORAGE BATTERY ROAD.—WAITING ROOM AT CONNECTION WITH ALLEY "L" ROAD.

a vestige of the original telegraph system of the Union Pacific remains. From time to time supplementary contracts were made, modifying or amplifying the original one, until to-day it is quite impossible to tell one clause from another. The Western Union claims all the lines in use along the right of way of the Western Union, and, having been so long in possession, is in a position to maintain its claims. Then, too, the railroad can scarcely dispute this claim, since in equity it appears to be a just claim. So this practically forces the railroad to put in a new system of its own. This means a parallel system half way across the continent. It will mean two telegraph offices in each town of any consequence between the Missouri river and the Rocky Mountains and a duplicate set of telegraph operators.

It is not, however, wholly settled that the railroad company will surrender everything to the Western Union. Though the Union Pacific is at work constructing its new independent line, there is yet a probability that the officers will insist on a commission being appointed to investigate the situation and make an award of the properties of the two companies. If this is done it will be probably by the employment of some of the old employes who were associated in the original construction of the Union Pacific's telegraph lines.

There will be much confusion in commercial business between the East and West, since the two companies must establish separate offices and all business originating on the Union Pacific for outside points must be handled twice the number of times now necessary, and business going overland or to points on the Union Pacific must be transferred also at Omaha. This is certain to double the expense of telegraphic messages to the patrons of the company and result in numberless annoyances that the public is not now subjected to. One feature of this case is that all other railroad companies in the United States are liable to be forced into the position now occupied by the Union Pacific, since

ENGLEWOOD AND CHICAGO ELECTRIC STORAGE BATTERY ROAD.—POWER HOUSE AND CAR BARN.

the relations of the telegraph company to the other roads of the country are exactly similar to that of the Western Union with the Union Pacific.

Hereafter the Chicago City Railway company and the Chicago General Railway company will dwell together in peace and harmony. There will be no more smashing of cars, no more litigation. Everything has been settled satisfactorily, and the new company will use the tracks of the old corporation, paying a stipulated rental for the privilege. By this arrangement the Chicago General Railway company secures a line extending from Lawndale to the lake on Twenty-second street. Both companies are well satisfied with the arrangement.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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CIRCULATION, 20,000.

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With the Niagara Falls convention number of the Western Electrician, dated June 12, 1897, this journal made a new record for itself both in circulation and advertising. Of this 100-page number 20,000 copies were printed and circulated and the amount of full paid advertising matter carried was 8,643 square inches.

The remarkable success of this journal, especially in view of the hard times that have prevailed throughout the country, is all the more striking because of the fact that it is only 10 years since the first number was issued. Its advancement has been rapid and in keeping with the progress of the great industry it represents and the splendid field which it occupies. It is a noteworthy fact, especially in view of existing conditions, that during the period of depression this journal has made steady gains in advertising. Beginning with the convention number of March 3, 1894, the record shows constant gains each year until in the present case the number of square inches of full paid advertising matter is more than double that of the 1894 number. The figures showing this unprecedented gain are given in the accompanying table:

Issue	Number of Advertising Pages.	Whole Number of Pages.	Square Inches of Paid Advertising Matter.
March 3, 1894....	40	56	4,145
February 23, 1895.	52	68	5,593
May 9, 1896.....	72	88	7,576
June 12, 1897.....	80	100	8,643

This constantly increasing patronage speaks eloquently of the influence and merit of this journal and of the confidence and respect which it commands throughout the country. It is pleasing recognition of the efforts that have been made in the interest of the entire fraternity.

Boston can well afford to stand the pleasantries directed at it by other cities if it succeed in effecting the reform inaugurated upon its street car lines last week. Hereafter conductors and other employes of the Lynn and Boston Railroad company, who have occasion to address the women patrons of the company, will use the word "madame," instead of "lady," as has been the custom heretofore. Now, if the manager of some line will only set the example by instructing his employes to discontinue the use of the term "gents," a great advancement will be made. When street railway companies show interest in such matters it is not too much to expect that "pants" and similar terms may cease to be favorite expressions in New York.

An example of advanced practice in storage battery street railway construction is presented in the Englewood and Chicago storage battery road, which is the subject of the leading article in this week's issue. Mr. Damon says that this plant is really a demonstration of the practicability of the storage battery traction system, rather than an experiment. The problems which naturally presented themselves in an undertaking of this character have had the earnest consideration of experienced engineers, and in their successful solution rests the hope of the storage battery for traction purposes in this country, for the present generation at least. There are many features in this plant that impress the observer with the advancement that has been made during the last few years in the application of the storage battery to commercial use. The plan for handling the cells, with its many details, is an illustration of this. Labor has been reduced to a minimum, and the same ideas of economy of operation have extended to all parts of the system. It has been the aim of the management to secure a model equipment, and the result can be judged pretty closely by those who carefully peruse Mr. Damon's article and examine the illustrations which accompany it. If street railway managers can be induced to look with favor upon this system of transportation, many streets in exclusive residence districts may be occupied that would be forever closed to the overhead trolley and even the underground conduit trolley system.

Some of the eastern newspapers have made themselves ridiculous during the last two weeks by their sensational stories concerning the so-called seizure of Palmyra Island, in the Pacific ocean, by the British government. The island has long since been recognized as a British possession, and may possibly be utilized as a cable station. Admiral Walker, who has given considerable attention to the Pacific islands, in speaking of the British claim to Palmyra, says the possession of that island means a cable station. Great Britain, he said, would not land a cable on any island unless she had absolute control over it. While an island of the Hawaiian group would have been preferred by Great Britain, Palmyra will answer every purpose for a cable station. Palmyra Island is not, geographically, one of the Hawaiian group. It is separated from the latter by a thousand miles of open sea. It is one of the Central Polynesian Sporades, and has been occupied by Great Britain during the last ten years. In fact, the only significant part of the whole proceeding at this time is the evident purpose of the British government to protect its interest so that it can have a cable station in or near the Hawaiian islands. The British survey steamer Penguin has just completed the preliminary survey for the Australian-British Columbian cable. She ran a line of soundings from Palmyra Island to a point 300 miles to the southward of Honolulu, finding an average depth of 2,700 fathoms. She is now undergoing general repairs at Honolulu and will return to Palmyra Island and run a line of soundings southwest to Sydney. The Penguin left Sydney on April 10th, proceeding by way of Suva Fiji to Palmyra Island, where a party was landed to observe the tides. The steamer then proceeded to the north and made an accurate survey of Kingman reef, which was found to be 60 miles due north of Palmyra Island. Twenty days was consumed in a fruitless search for the Calder and Maria shoals, and then the Penguin proceeded to Fanning Island, which was surveyed and an accurate map made. The officers of the Penguin say that Palmyra Island was claimed by the Hawaiian government in 1862, but that it was sold to private persons who went into bankruptcy and let the island go. Afterward some San Francisco men got hold of the island, but they, too, gave it up. In 1889 a British cruiser made a survey of the island and claimed it as a British possession, the union jack was raised and a proclamation, printed on a board, was set up in a prominent place. The Penguin found them very much dilapidated and the proclamation almost unreadable, and so it restored both. This is evidently the only ground upon which the bugaboo about the British seizure of the island was based.

In a recent article on seamanship and the responsibility of an admiral in managing a fleet of battleships, Charles H. Cramp calls attention to the changes that have been made in the equipment of large vessels, and he institutes a comparison between the first and last battleships built by his company for the government, showing the advancement that has been made in 35 years. The first was the New Ironsides, built in 1862; the last is the Iowa, completed in 1897, each fairly representative of the maximum development of its day. The New Ironsides had one machine, her main engine, involving two steam cylinders. The Iowa has 71 machines, involving 137 steam cylinders. The guns of the New Ironsides were worked, the ammunition hoisted, the ship steered, the engine started and reversed, her boats handled—in short, all functions of fighting and maneuvering—by hand. The ship was lighted by oil lamps and ventilated, when at all, by natural air currents. In the Iowa it may almost be said that nothing is done by hand except the opening and closing of throttles and pressing of electric buttons. Her guns are loaded, trained, and fired, her ammunition hoisted, her turrets turned, her torpedoes—mechanisms of themselves—are tubed and ejected, the ship steered, her boats hoisted out and in, the interior lighted and ventilated, the great searchlights operated, and even orders transmitted from bridge or conning tower to all parts by mechanical and electrical appliances. Mr. Cramp contends that a commander should be sufficiently familiar with the apparatus employed for this service to detect faults in construction and operation without depending entirely upon subordinates.

In spite of the recent heavy rains in New York, resulting in swollen creeks and other water courses that overflowed much meadow land and injured the quality of the hay by submerging it, the price has been unusually low, and the farmers are of course looking about for an explanation. The reason generally assigned for the anomalous decline in the price of hay, corresponding with the reduction in the product, is "the steady decline in the demand for hay and oats consequent upon the increased use of steam power and electricity for traction purposes, further enlarged this year by the introduction of horseless carriages. With the decline in the number of horses in use and the need of horses there has been a corresponding reduction in the demand for fodder." So far as this explanation relates to trolley lines, it is doubtless correct, but it will undoubtedly be news to most people that the development of the horseless carriage business has in any way affected the market. However, some enthusiasts seem to look upon the subject as being fully settled in favor of the motor cart. For instance, in speaking of the arrangements for an exhibition and race of horseless carriages in France recently, Figaro said: "The organization was perfect. The mounted gendarmes, imposing on their large chargers—last vestiges of a breed destined to disappear—preserved good order, so that no imprudent person should slip into the midst of the vehicles, which formed a long file on the road facing the stands, and the competitors themselves quietly took their places near the trees, which bore numbers corresponding to those on their carriages." Generally speaking, it is safe to say that American opinion on this subject is not as far advanced as that expresed by our contemporary.

Design and Construction of Electric Power Plants.

By Bion J. Arnold, M. S.

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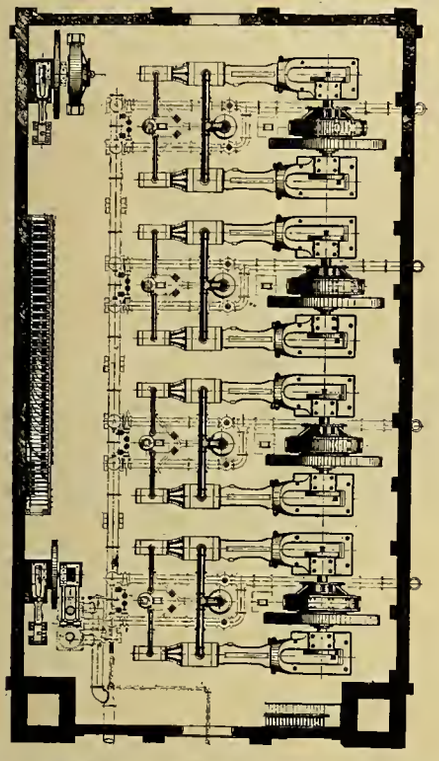
Part XI.

Buildings and General Arrangements.

One of the most important questions of the entire problem of power-plant design is the arrangement of the machinery and the station accessories. So many arrangements are possible, and the convenient and even economical operation of the plant depends so much upon the selection of the right one, that the careful engineer will be slow in arriving at his decisions. The number of possible arrangements will depend largely upon the location and environment of the station site and also somewhat upon the kind of machinery to be installed.

One of the principal things to be borne in mind is



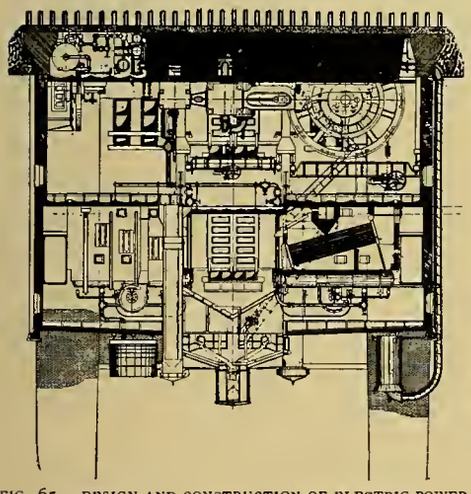


FIG. 65. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—STATION OF PEOPLE'S TRACTION COMPANY, PHILADELPHIA.

to allow ample provision for increased capacity. It is advisable to lay out the power house for much more than the immediate needs, the amount of increased capacity provided for depending upon local conditions.

The next important consideration is convenience of operation, and much consideration should be given each case, so that the plant when completed may be operated with the minimum amount of labor. For this purpose full knowledge of the best devices for handling the fuel and for disposing of the ashes will be advantageous. Many times, if the proper arrangement is adopted, the coal can be delivered immediately from the cars directly upon the boiler room floor, or perhaps in storage bins above the boilers, and thus the cost of handling the coal is reduced to a minimum. A saving of but a few cents a ton may appear like a small matter, but the total saving in the fuel bills of the entire year, if capitalized, would represent no inconsiderable investment, and can be effected often by foresight in planning the station.

Another important consideration, which will have more or less influence upon the design, is the necessity of abundant light and air, and in order to secure them the design will often be affected by the character of the surrounding buildings. But, as a rule, the power station building itself, from the architectural point of view, may be very simple in design and ornamentation, as long as it is substantial and suited to the purpose. It may be well here to indicate the line separating the duties of the power station designer and the architect. It

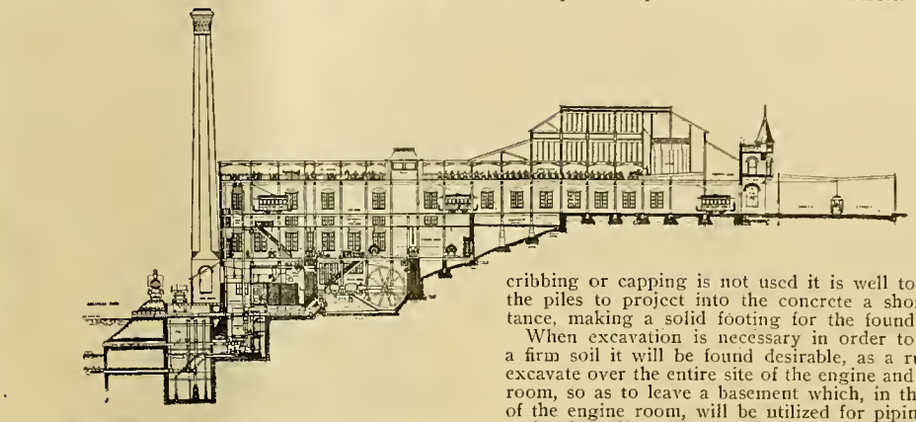


FIG. 66. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—STATION OF THE CITY ELECTRIC STREET RAILWAY, LITTLE ROCK, ARK.

will always be found preferable to intrust the design of the building proper to an experienced architect, for such a man, if competent, will frequently save the cost of his services many times over by adopting methods of construction which will prove to be as satisfactory as those more expensive. But the power station designer should early insist that the architect recognize the purpose of the plant to be one of utility rather than beauty, and should see that none of the desired convenience be sacrificed to contribute toward some architectural effect. It is well for the machinery part of the plant to be laid out first and afterward surrounded with the plan of the station building, and with a new plant this can usually be done. In cases where the design of the building is determined by the shape of the property, as is often the case in crowded districts, the machinery must be arranged to fit the building. The designer of the plant must keep in mind, however, the limitations of building construction, and lay out a plant which will avoid wide spans of roof trusses or other details which will make the building too expensive.

Foundations.

The first thing to be done on the building part of the power station problem will be the determination of the kind of foundations needed. The site chosen may provide solid rock foundations, in which case it will simply be required to level off the surface to provide for the building footings, or, in the other extreme, the site may be upon very soft ground, which will require the driving of piles over the entire area. It will generally be found necessary to make some investigation into the nature of the soil which is to support the building and machinery. This can be done by digging trenches which will show the successive strata of earth, or preferably by boring test holes or by driving down ordinary gas pipe, which will collect and show the character of the ground underlying the site.

The usual data for the safe-bearing power of soils are given below:

Kind of Material.	Bearing Power in tons per square foot.	
	Minimum.	Maximum.
Rock, the hardest, in thick layers.....	200	.....
Rock, equal to brick masonry..	25	30
Rock, equal to poor masonry..	5	10
Clay in thick beds, always dry.....	4	6
Clay in thick beds, moderately dry	2	4
Clay, soft.....	1	2
Gravel and coarse sand, well cemented..	8	10
Sand, compact and well cemented.....	4	6
Sand, clean, dry..	2	4
Quicksand, alluvial soils, etc.....	.5	1

When the soil is of a compressible nature several methods are followed in obtaining a firm bed for the building and machinery. Short piles are sometimes driven over the entire site, and in other cases the whole area under the power plant is covered with a monolithic bed of concrete, to a depth of two feet or more, the object being to distribute the weight over as large an area as possible. More frequently, however, it will be unnecessary to cover the whole area with an underfooting of concrete. In such cases trenches are dug following the outlines of the walls of the building, and these trenches are filled to a depth of six to eight inches with concrete, upon which the footing courses of the building are placed. These footings will consist of brick or stone and will be laid in courses, the lower course being much wider than the wall, and each successive course being somewhat narrower until the thickness of the wall is reached.

In cases where the ground is very soft it will be necessary to drive piles of some length into the ground. These piles may consist of a variety of woods (preferably white oak), but should be of perfectly straight, round timber, and care should be taken to drive them vertically. It is important that they be sawed off below the water line, so that they will always be submerged, as otherwise they would rot quickly on account of being exposed to the atmosphere. A timber cribbing, which should also be submerged, is as a rule placed over the tops of the piles and filled with concrete. Where cribbing or capping is not used it is well to allow the piles to project into the concrete a short distance, making a solid footing for the foundations.

When excavation is necessary in order to reach a firm soil it will be found desirable, as a rule, to excavate over the entire site of the engine and boiler room, so as to leave a basement which, in the case of the engine room, will be utilized for piping and under the boiler room for ash pits and air chambers. The foundations for the engines and generators will require especial attention, as these portions of the equipment of the power house contain moving and reciprocating parts, and vibration must be guarded against. The depth of the foundations for these particular machines will be determined often by the head-room allowed in the basement, as their foundations will extend from the grade line or the top of the concrete to the engine and dynamo room floor.

The foundations for the machinery can be made of brick, stone or concrete. In laying out these

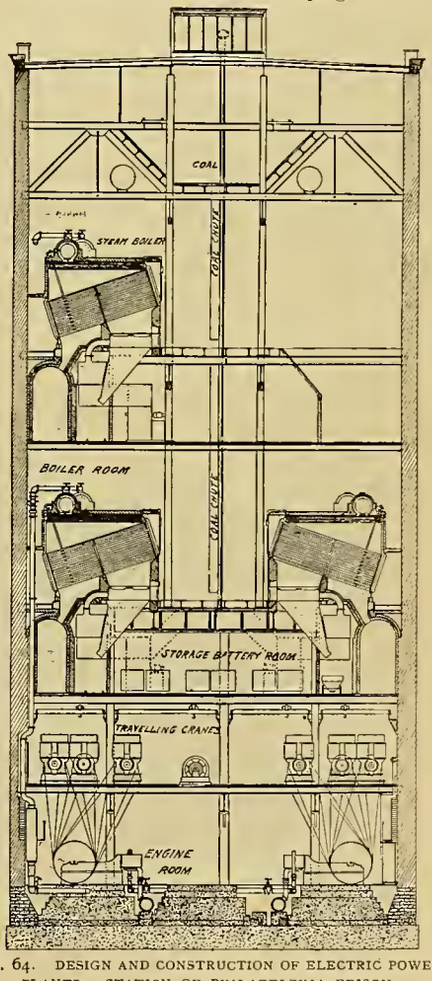


FIG. 64. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—STATION OF PHILADELPHIA EDISON COMPANY.

foundations solidity is the first thing to be considered, and calculations upon the supporting strength will, as a rule, be uncalled for, as the foundation will always be sufficiently strong to support many times the mere weight of the machinery.

Where the entire foundation of machinery and building is upon solid rock, or in any other case where it is desired to prevent the vibrations of the machinery being transmitted to the building proper, as with an isolated plant in an office building, it will be well to "deaden" the machinery foundation. This can be accomplished by surrounding the foundations on the sides by some such material as sand, cork, mineral wood or asphaltic concrete, and a

layer of the same material is also laid under the foundations.

Before the foundations for the engines and generators are built a template, consisting of a light framework, accurately laid out according to the subbase designs, is suspended above the space provided for the foundations. From this template the holding-down bolts are hung accurately in position. These bolts are provided with foundation plates at their lower extremities, which prevent the bolt heads from crushing the foundation material. The foundation is built up around these bolts, though some slight play must be allowed at the top of the bolts in order to easily fit them into the cast-iron subbases. This play is sometimes provided for in another way by building into the foundations suitable boxes large enough to easily carry the bolts, and after the foundations are finished, the bolts inserted and secured to the machinery, the spaces surrounding the bolts are filled with cement mortar, poured in when in a liquid state.

Any part of the building subjected to vibration or to considerable weight should be built with cement mortar. Lime mortar is liable to crumble under vibration or great stress, and therefore is unsuitable for foundations, and should never be used. All brick used in machinery foundations should be hard-burned and of good quality. Concrete generally consists of what is known as "1—3—5" mixture, one part of Portland cement, three parts of clean, sharp sand and five parts of broken stone, broken small enough to pass through a two-inch mesh. In laying the concrete for machinery foundations a mold of boards is made, the exact shape and size of the desired foundations. Into this mold the concrete is filled immediately after being mixed, and is tamped to place in layers from six to 12 inches thick. Each layer is allowed to set slightly before applying the next course. If the work is stopped over night or longer, so as to allow the top course to set thoroughly, it should be well washed and roughened by means of a pick before applying the next course. For small foundations brick will be found the cheaper, but for large foundations concrete can be most economically used.

WALLS.

The walls of the building will be of wood, stone, iron or brick. Wood is not advisable on account of the fire risk, and wooden construction in any part of the building is rapidly giving away to the numerous forms of "fireproof" construction now in vogue. Stone will be used in certain localities where it is plentiful and in places where a very ornamental effect is desired. Iron and steel are often used for the framework of the structure, being filled in with a veneer of brick or stone work. Brick will probably continue to be the most common material for power station walls, however, and in city plants and others where ornamentation is desired the exterior walls should be veneered with pressed brick.

The thickness of the brick wall will depend upon the size of the station, and will vary from 12 inches in the small stations to 17, and even 30 inches, in the large power houses, depending upon the height.

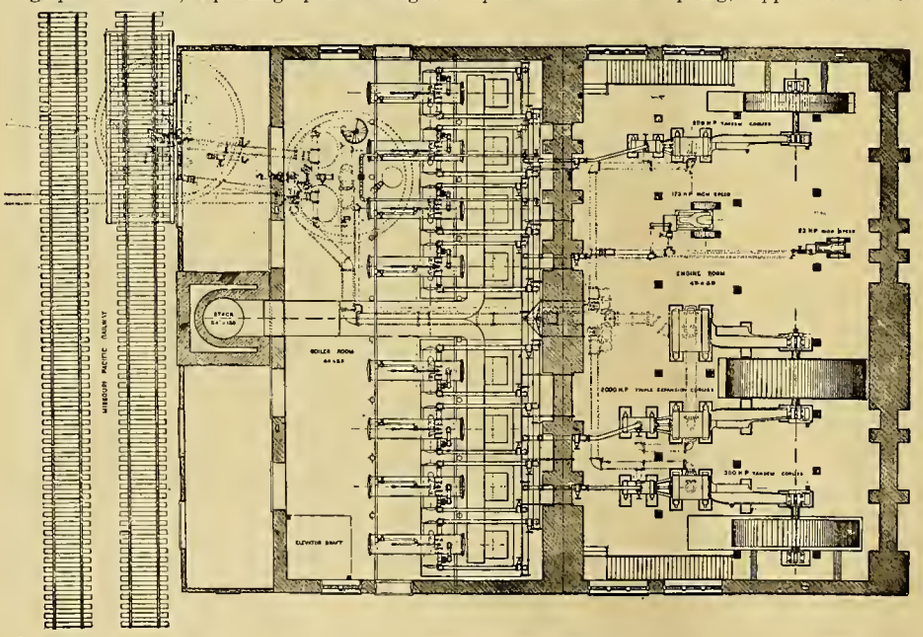


FIG. 67. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—STATION OF CITY ELECTRIC STREET RAILWAY COMPANY, LITTLE ROCK, ARK. (PLAN).

If the roof is supported by trusses, as will be most likely, each truss will be supported by a pilaster, which will be at least four inches thicker than the connecting wall, and have a face of about two feet. Where a crane is installed pilasters, additional to those required for the roof, will be provided to support the track. Iron columns for supporting the roof trusses and crane track, built into the walls, are sometimes used.

TYPICAL STATION ARRANGEMENTS.

That we may have a better idea of the various types of power plants it will be instructive to examine some of the arrangements adopted in a number of power stations.

Philadelphia Edison Station.—Fig. 64 is typical of a number of low-pressure incandescent lighting central stations which are constructed two and three stories high in order to overcome the disadvantages of expensive ground space. Here the engines are installed upon the ground floor and the generators are placed upon the floor above and connected to the engine fly-wheels directly by means of belts. The boilers, containing no moving parts of any importance, set up no vibrations, and therefore, if sufficient support is provided for their dead weight, can safely be placed anywhere in the building, and in this case are erected in two tiers above the engines and dynamos. Storage bins for the coal are placed at the top of the building, from which the fuel can be delivered conveniently to the floor of the boiler rooms by means of chutes. The ashes are caught in pockets beneath the boilers and removed by means of ash cars. Between the lower tiers of boilers a storage battery room is located. Taken all in all, the arrangement is about as compact as could be built at the time it was installed, for then only belted generators were available, but at the

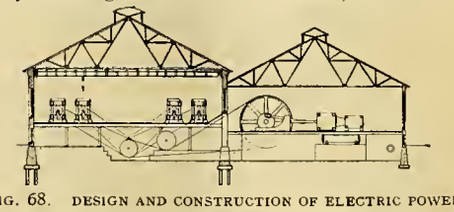


FIG. 68. DESIGN AND CONSTRUCTION OF ELECTRIC POWER STATION OF NARRAGANSETT ELECTRIC LIGHT COMPANY, PROVIDENCE, R. I. (TRANSVERSE SECTION).

same time it furnishes a very good example of "how not to do it," unless the conditions make it imperative. The dynamos being driven by vertical belts, running at an angle with the horizontal of more than 45 degrees, cannot be expected to operate satisfactorily without close attention. As such a station is usually built in a district where it will be surrounded by other buildings, artificial light must necessarily be depended upon for a good part of the building, and the most careful preparations must be made to secure proper ventilation and provide air for combustion. The fumes from the battery room must be guarded against, or they will attack the iron of the building and of the boilers. Inconvenience of operation makes the upright plan anything but an ideal one, and it should only be adopted for those low-pressure systems of supply in which the necessity of placing the power station near the center of distribution locates the plant in a crowded district where the cost of real estate is high.

Power Plant of the People's Traction Company, Philadelphia.—An arrangement which may well serve for a model, where a two-story station is necessary, is shown in Fig. 65. The building is built upon a foundation of piling, capped with concrete. The plant is not surrounded with other buildings, and therefore has an ample supply of light and air. The generator units are of the direct-connected type, and therefore lend themselves to a compact arrangement and are free from the objection to belts mentioned in connection with the preceding case. The switchboard is conveniently located on the engine room floor. The live-steam piping is simple and direct, while the basement allows an accessible arrangement of the exhaust and condenser pipe lines. Ash conveyers carry the coal to storage bins above the boilers. Two cranes are provided for handling the heavy machinery in the engine and dynamo room, the supports of the building making possible the adoption of cranes of short span. One objection which might be found to the plan is that evidently no arrangement has been made for extensions.

Power Plant of the City Electric Street Railway, Little Rock, Ark.—Fig. 66 is typical of a power station built according to "mill" construction." Here the engines and boilers are placed upon the natural solid slate foundations, and the dynamo room is located above. The fly-wheels of the engines are connected by means of belts to two lines of countershafting. Belted to one line of shafting are the rail-

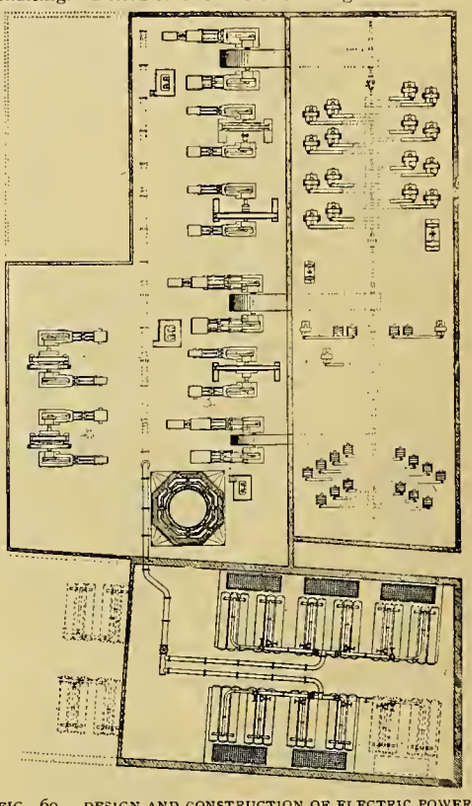


FIG. 69. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—NARRAGANSETT ELECTRIC LIGHT COMPANY, PROVIDENCE, R. I. (PLAN).

way generators and to the other the dynamos used for lighting. The two sets of shafting are cross-connected by means of a large belt, so that any generator in the plant can be operated by any engine. The plant is located upon the side of an embankment, so that the car barn, above the dynamo room, comes on the level with the street. The floor of the car barn is inclined, so as to make the removal of the cars a comparatively easy matter in case of fire. Above the car barn provision was made for a summer theater, and the offices of the company are located in the front part of the building opening into the street.

Fig. 67 is a plan view of the same station, showing the arrangement of boilers and engines. The engine room walls were used for the purpose of providing a foundation for the two lines of shafting. The boilers are backed up against the wall separating the boiler and the engine rooms, with a small space between, and the engine cylinders are similiarly placed, so as to allow the shortest and simplest steam-pipe connections. All the steam piping is in duplicate to insure reliability. The condensers are placed in a pit which had formerly been used for a water-works well at the back of the building, and the supply of injection water is obtained from the adjacent river. Upon each side of the stack are placed the coal sheds, within easy reach of the railroad siding running in the rear of the building.

The advantage of this arrangement is compactness, thus necessitating a small amount of real estate and permitting the entire building, including power house, shops, car barn and offices, being placed under one roof, with the consequent low first cost. The disadvantages are that the fire risk is greater than with detached buildings, and the space occupied by the machinery is much greater than would be required at present by the use of direct-connected units, which could not be obtained when the plant was built in 1891.

Power Plant of the Narragansett Electric Light Company, Providence, R. I.—The power station shown in Figs. 68 and 69 is a typical composite station designed to furnish current for a variety of purposes, and contains generators both direct-connected and belt driven. The arrangement of counter-shafting is shown, and it will be seen that the shaft is located in an alley under the dynamo room and connected to the engine wheels by belts fitted with belt tighteners. The dynamos are operated by belts passing up through the floor. This arrangement insures a neat-looking and open dynamo room, but requires considerable space. The roofs are of iron, surmounted by monitors for light and ventilation. The dynamo room is provided with a traveling crane, which insures easy handling of the armatures or other parts of the generators.

The plan of the station shows several features which it would be well, if possible, to avoid. The location of the boiler room makes necessary a very long live-steam header, which will contribute its full share to losses by condensation. The header is supplied with steam from the boilers at one point only and that at the extreme end. If anything should happen to the header near the boilers, the entire plant would be crippled. Each boiler is supplied with an individual economizer, which seems like an unnecessary expense, as when any boiler is not being operated the corresponding economizer is also out of use. One economizer of a size much less than the combined capacity of the individual ones installed would do the work and take up much less space. The location of the stack is unfortunate, as it takes a large amount of space which is desirable for generating machinery.

[The concluding portion of "Buildings and General Arrangements" will be given next week. This will end the Arnold series of lectures.]

Three-phase Mining Machinery.

The comparatively recent developments in the manipulation of the alternating current have, in broadening the whole field of electrical application, extended the use of the current also in the mining industry and given to the mine operator a system extremely efficient and flexible both in its distribution and adaptation. The alternating current possesses one great advantage, among others, which no other system presents, in the ease with which the voltage may be varied. This is done by means of transformers and allows the electricity to be transmitted at a high voltage, and, consequently, cheaply, over long distances, to be transformed down at the point of utilization. It also allows of the use of motors which, equally effective in their performance with direct current motors, are free from commutators and moving contacts, and consequently from sparking, as well as from other shortcomings.

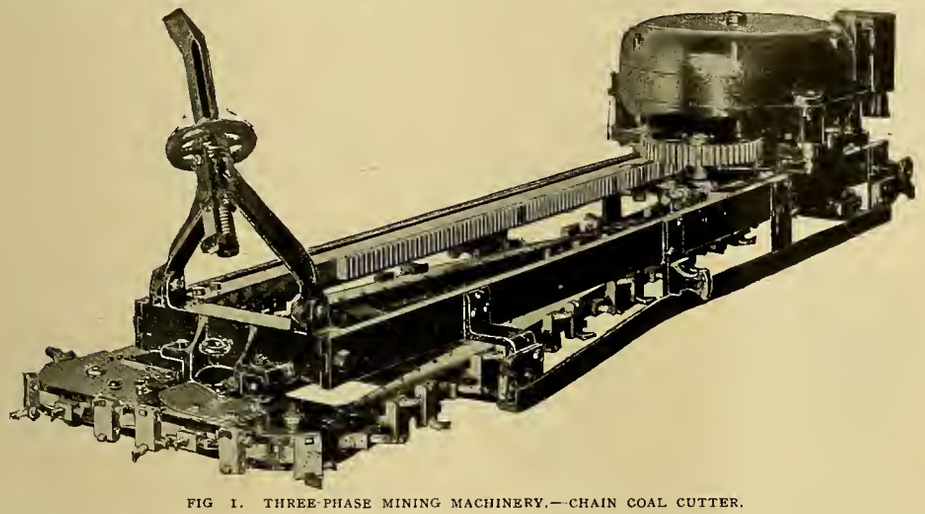


FIG 1. THREE-PHASE MINING MACHINERY.—CHAIN COAL CUTTER.

To the mine operator the alternating current system, or rather a modification of it known as the three-phase system, offers special advantages. Mines many miles apart may be operated by current generated at a single central point, situated where it can be procured and distributed most economically. The electricity, transmitted at a suitable high voltage, on reaching the mine mouth is reduced in pressure, and the wires taken down the shafts carry a low voltage current only. It can then be used not only to drive the mine machinery but also to light arc and incandescent lamps on branches from the same main circuits, at even a lower voltage than that used for the machines. In case continuous current is required in lieu of alternating, as for the operation of mine locomotives, the alternating current can be converted into continuous in a rotary converter, and the voltage of the latter current regulated to the necessary potential for the new use. Furthermore, although three wires are used with the three-phase system and two with the direct, the cost of the three wires is one-quarter less than that of the two wires, allowing the same loss in transmission and using the same initial voltage.

The development of electric mining machinery to be operated on the three-phase system has been carried forward vigorously by the General Electric company, and, convinced of the advantages of the system, while recognizing the need of propaganda, it equipped a large freight car as a central three-phase station, with boiler, engine, alternator and station equipment complete. This was held ready for installation at the mouth of the mine of any operator desirous of investigating the economy and efficiency of the system. The installation made, station and mine apparatus were left with the operator. He was then placed in a position to watch both generating and operating machinery and judge for himself. This car was never long out of requisition.

To the cutting of coal by machinery the three-phase system seems peculiarly suited. The chain coal cutter (Fig. 1) shows the latest type—a stationary frame and traveling carriage carrying the motor, driving gear, feed gearing and cutting chain. The motor is an induction motor laid on its side. It has neither commutator brushes nor moving contacts, and as it cannot spark can be used in gaseous or dusty mines where a spark might result in a costly disaster. The windings of the motor are stationary coils, embedded in metal and protected from injury, and as these coils are separately formed and insulated, they may be readily removed and replaced. The motor is entirely inclosed, and no starting box being necessary, complete control is given by a simple inclosed switch. The motor stops work the moment it is overloaded, and the machine is thus subjected neither to strain nor breakage. The shaft of the motor is vertical and runs at a low speed, allowing the chain sprocket wheel to be driven by a single reduction spur gear, thus avoiding on the main drive both worm and bevel gears. The feed gearing is driven by a worm at the lower end of the armature shaft. The backward thrust of the feed gearing is taken by a single rack, so located as to compensate largely for the side thrust of the chain as it cuts the coal. Into this rack mesh two pinions, one for the forward and one for the backward motion of the carriage. The reverse lever at the back of the machine throws clutches in or out of these gears and is arranged to throw automatically when the end of the cutter travel is reached. A characteristic feature of this cutter is the small amount of gearing employed and the reduced number of wearing parts.

The chain is arranged to take three shapes of bits, each form cutting grooves about 1½ inches deep, separated from the next groove by a ridge of coal, which is broken down by the links. The cut is about four inches high by 36 inches wide, and the bits, made in the form of an arc of a circle, can be set out as required. This gives a great advantage in shapening, as no part of the bit except the cutting edge needs redressing and all of the steel may be used up. The chain is built to stand the strain and the vibration of the cutter. The bit links are of tough phosphor-bronze, and the strap links are steel drop forgings, of such shape as to bring all the strain directly upon the solid forgings and not on the rivets.

In rooms where the proper clearance can be obtained, this coal cutter can be shifted or moved from the first position ready for the second cut in an average of two minutes, it being understood that the props are away from the face, the floor reasonably smooth and the face of the coal properly squared. The time of loading and moving the cutter from room to room will average about 15 minutes, provided the rooms are adjacent. The time required for setting the bits will average 10 minutes. The cutter has in favorable coal, where other conditions were rather unfavorable, such as roof, props, track, etc., been able to average eight cuts or runs each 36 inches wide, per hour, or at the rate of 240 lineal feet per 10 hour shift. The conditions can scarcely be so unfavorable that it will not always be able to average at least four runs per hour.

An approximate idea of the number of machines required for any particular mine can be obtained from the following formula, which gives the tonnage output:

(Number of feet face per 10 hour shift) × (depth undercut) × (height coal) ÷ 27 cubic feet = number of tons run of mine coal.

To reduce this to lump coal the percentage of fine coal that passes through the screens from pick-mining is ascertained. The percentage of lump from the machine will then be 25 per cent. greater than when produced by pick or hand labor. The amount of powder to shoot or break down the coal is also largely decreased. Any coal that would require ordinarily an 18 inch cartridge to break down, will require, when the same coal is properly undercut with the machines, an eight inch cartridge for the same or a greater amount of coal.

The electric mining pump has the great advantage of portability, which renders the electric pump superior for mine work to pumps driven by any other method. With an electric pump the pump shaft is free from all machinery. It contains only the conductors and discharge pipes. Indeed, the three-compartment shaft so common in mines, one for pumping and the other for hoisting, can, by the use of the electric pump, be reduced to two, as the discharge pipes and wires which occupy so little space can be placed in one of the hoisting compartments. Furthermore, with an electric pump, deleterious and often disastrous effects inseparable from the use of steam are absent. Moreover, the three-phase pump requires no attention beyond an occasional oiling, and needs no attendant to start or stop it. It can be operated by a switch from the engineer's office at the mine mouth.

There are different types of electric mine pumps, but the three-phase pump presents features of excellence similar to those noted in the coal cutter. Fig. 2 shows a Knowles 7¼ inch by 12 inch double acting horizontal triplex pump, having a capacity of 600 gallons a minute, against a head of 200 feet. The motor is also of the sparkless induction type, but of 75 horse power capacity, and the outside dimensions of the combination of motor and pump are nine feet high, six inches wide and 25 feet by 6 inches deep. This mine pump is now in use in Mexico.

FIG. 2. THREE-PHASE NMINING MACHINERY.—DOUBLE ACTING HORIZONTAL TRIPLEX PUMP, 75 HORSE POWER INDUCTION MOTOR.

The induction motor is also applied to the mining hoist.

Generally speaking, the use of electric mining machinery reduces materially the amount of dead work, and in the case of the cutter reduces the amount of haulage. These two factors alone result in a decreased cost of mining, and although it is difficult to state the extent of the saving, the practical operator will be able without effort to realize the benefit derivable from the use of electric mining machinery. Beyond those already mentioned the following may be enumerated: Ventilating fans may be placed in any part of the mine and be driven by motors; partitions can be lighted by incandescent lamps; the coal can be hauled by electric locomotives, and all with no greater encumbrance in the mine workings than some small wires strung on porcelain conductors out of sight, almost on the roofs.

American Institute of Electrical Engineers.

[Special correspondence of the Western Electrician.]

The American Institute of Electrical Engineers on Monday, July 26th, opened a week's session at Greenacre-on-the-Piscataqua, Eliot, Me., a little town near the New Hampshire boundary, to celebrate the semi-centennial of an event which has led to results of almost incalculable importance to modern civilization,—the successful operation of an electric passenger car, which was publicly exhibited for the first time at Dover, N. H., July 26, 1847. It was eminently fitting that the event should be commemorated at Greenacre, for it was there that Moses G. Farmer, the pioneer electrical inventor, made his home for many years, and it is there that his daughter, Miss Sarah G. Farmer, has established a summer school, where representative men and women in the spheres of literature, science, art and religion congregate for mutual instruction and improvement during the months of July and August of each successive year. The members of the Institute arrived at Greenacre Monday morning and Miss Farmer personally welcomed the distinguished company of scientists.

The meetings were held in Eironion Hall, where W. S. Key of Boston had arranged an exhibition of photographs and electrical models, among which were several of the crude appliances Prof. Farmer used in his early experiments. The exercises were opened by Prof. Cyrus F. Brackett of Princeton, who read a paper on "The Past and Present Outlook of Electrical Science." Prof. A. E. Dolbear of Tufts College then presented a careful and comprehensive review of the work of Moses G. Farmer as an electrical pioneer. He referred to many of the men who had experimented with electricity along the lines which Prof. Farmer followed, pointed out the fact that whereas others had dropped their researches, failing to see the vast importance of the possible results, Farmer continued his efforts until he had triumphantly operated an electric car, lighted his house with incandescent electric lamps, utilized the mysterious force in cooking, established a fire-alarm signal system and rendered other services to the world which are now, after many years, fully appreciated. In the evening Prof. Edward F. Barker of the University of Pennsylvania formally welcomed the members of the Institute. Prof. F. B. Crocker of Columbia College, president of the Institute, responded.

In the Eironion, which was simply but tastefully decorated with evergreens, was opened the exhibition of the Farmer apparatus and models. The engine devised and exhibited 50 years ago had not arrived, though it was expected, as it had been loaned by the National Museum at Washington. Among the most interesting of the exhibits were three fire-alarm boxes, showing stages in the perfection of the device; the second from the custom house, the third from the Sherman house, Boston (1864); a keyboard transmitter for transmitting the fire call; an eight-function keyboard, whereby eight different messages could be sent over one wire; a torpedo exploder for exploding by electricity torpedos or for blasting purposes, with an automatic alarm warning the operator of the instant the explosion should have taken place; a printing telegraph operating box; several self-regulating arc lamps and regulators; a broiler on which Prof. Farmer broiled chops and steaks in 1850 by electricity; a cable testing apparatus; some incandescent lamps, 1870-1874; an electric perforator for cable transmission; the modern ticker; apparatus for generating and storing electricity by windmill for use in lighthouses; an early reversible electric motor which had the honor of settling forever a hopeless dispute between rival inventors, proving conclusively that both had been anticipated and ending the litigation; the keyboard for the first printing telegraph; a sliding non-adjustable rheostat; a thermopile, generating electricity from a gas jet; a tangent galvanometer and many more inventions testifying to his genius and mechanical skill. A number of models by Thomas Hall were also on display. On the wall was placed a magnificent portrait of Prof. Joseph Henry, loaned by the National Museum, and below it was his first dynamo. There were also a large number of interesting photographs of Prof. Farmer at various ages, and a most lifelike portrait in oil by the famous artist, F. H. Tompkins of Boston, showing Prof. Farmer as he appeared in his last years seated in his library, a large magnetic coil on a table near at hand. Sidney H. Short of Cleveland, the General Electric company, Prof. Elihu Thomson and the Pope Manufacturing company, sent many very interesting photographs of apparatus and inventions, while W. J. Hammer contributed his collection of autograph portraits of contemporary and pioneer electricians.

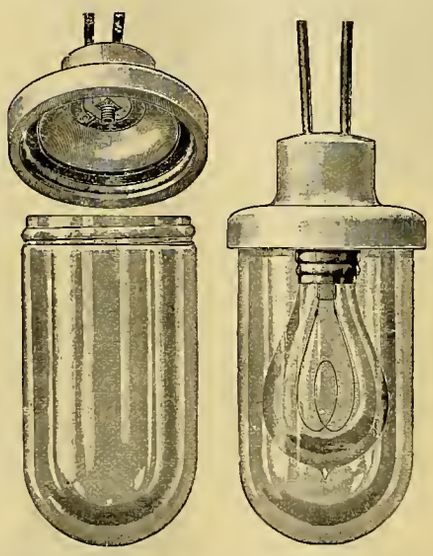
As this was the general meeting of the Institute a large number of valuable papers were read and discussed. The titles of these papers and the names of the contributors were presented in the Western Electrician on July 17th. One of the most interesting features of the meeting was Prof. Thomson's lecture, Wednesday evening, on the "Future of Electricity." The speaker believed there remained many applications of electricity not yet developed.

In compliance with a resolution presented at the Monday evening session, a committee, including Mrs. Ole Bull, Mrs. K. T. Woods, Profs. Barker, Dolbear and Thomson, was appointed to take in hand the subject of a Farmer memorial. Prof. Dolbear in his address had alluded to the neglect of Prof. Farmer's memory by those benefited by his achievements.

The visitors were given an opportunity to visit the Farmer homestead at Eliot, a mile from the meeting place, and all took advantage of it. The rooms devoted by Prof. Farmer to experiment and study have been preserved in the condition they were in at the time their occupant was called from his labors. They are filled with his apparatus, and form a most interesting reminder of the great genius of the inventor.

Prof. Owens took occasion to urge the claims of the West for the next general meeting of the Institute and extended a formal invitation to hold the meeting at Omaha in connection with the Trans-Mississippi exposition. The matter was referred to the council with the recommendation that Prof. Owens' invitation be accepted.

The way in which Moses G. Farmer became interested in electricity makes an interesting story. Along in 1846, while on his way to Boston on a business trip, Prof. Farmer happened to see a man reading a book entitled "Electro-magnetic Telegraphy," by Alfred Vail. He was prompted to purchase a copy of this book in Boston, and by the time he had reached home he had learned the Morse alphabet. This gave him a taste for electrical matters, and set him thinking and working on several problems. Foremost in his mind was the subject of how to utilize the force he was so fond of experimenting with for propelling vehicles, and so persistently did this idea retain possession of his mind that it took actual shape, and resulted in the construction of a train of two cars, on one of which was mounted the motor and battery which furnished the current, the other being a passenger car. An accurate sketch of this train was given by Prof.



NEWGARD WATERPROOF RECEPTACLE.

Farmer himself a few months before his death to W. S. Key of Boston:

The rails of the track were of cast-iron and the ties or sleepers of wood. The rails were about two feet in length, and the middle was deeper than the ends. The depth of the rail in the middle was about an inch and a half, or an inch and three-quarters. The thickness of this part of the rail was from one-eighth to five-thirty-seconds of an inch. The depth of the rail at the end was about an inch, and fitted into a groove sawed across the sleeper or tie. The latter was about two inches wide, and the end of the rail reached half way across it. The length of each tie was 18 inches, its depth being three inches. The flange of the rail was a little over three-eighths of an inch, its depth being rather more than an eighth of an inch. On these rails ran two cars, one for carrying passengers, the other being the locomotive, each car about four feet long and a foot and a half wide. The frame of the car was made of cherry. On the passenger cars were placed two seats, one at each end, the passengers facing each other. The seats were supported on C-shaped steel springs. They were upholstered in crimson plush. The wheels were of cast-iron, about six inches in diameter, and had flanges of a little over one-quarter of an inch in depth, being supported at the ends of a steel axle. The electric current was generated in 48 cells of Grove's battery, the size of a small beveled gear, and on the axle of the forward pair of wheels was a somewhat larger beveled gear. Connecting the two was an inclined axle, carrying two beveled gears. One of these engaged with the beveled gear on the axle of the armature wheel, and the other with that on the car axle. In 1850 the cars were exhibited in the city of New York, and there, as elsewhere, attracted universal attention. For some reason, however, the principles embodied in this great novelty were not immediately seized upon by electrical engineers, and for many years very little progress was made in the art. When at last the work of impressing electric current into general use for illuminating purposes had been accomplished, scientists turned their attention to electric traction, this time in earnest, and with what astounding results all the world knows and enjoys.

Newgard Waterproof Receptacle.

The cut shows a combination of waterproof socket and waterproof globe complete in one appliance. A single piece of porcelain forms a socket or receptacle for the lamp, and the cover for the globe. The conducting wires are permanenently sealed in this porcelain cap, which is threaded into the receptacle, and the glass globe and rubber gasket in the cover makes a water-tight fitting between the cover and the globe, making an outfit which can be used under water with perfect safety. It is used largely in breweries (several hundred having been placed in Chicago breweries already), packing houses and similar establishments where it is customary to wash the floors, walls and ceilings with showers of water. It will also be found to be a perfect solution of the difficulty in all places where severe conditions have heretofore made a perfect insulation of lamp and socket an impossibility, such as cold storage warehouses, paper mills, etc. The receptacle is made regularly with T.-H. base, but can be used with the Edison lamp and a T.-H. adapter. The globe will take either a 16 or 32 candle power lamp, the opening in the globe being 2¾ inches. The length of the globe is six inches, while seven inches is the length of the outfit over all. The Electric Appliance company of Chicago, which handles this specialty, will be glad to give further information.

Profitable Extensions of Electricity Supply Stations

By Arthur Wright.

Part II.

EFFECTS OF VARIOUS METHODS OF CHARGING.

It may be argued that if the principle of equal rates of profit from all consumers be carried into effect, it might result in a serious loss of revenue to the supply stations, owing to the large but short-hour consumers objecting to the higher rates thereby necessarily charged to them; in practice, this need not be feared, as consumers of that type are generally either unable to dispense with electricity or are in sufficiently good positions to be able to afford to pay comparatively a high price for the luxury of having the best light procurable for a short time per day or at irregular intervals. Moreover, any consumer discontinuing his supply for the reason that he was charged at a higher rate than his neighbors would not necessarily be a loss to the supply company, as, unless he is a source of profit, the plant allocated to his wants could be better employed; in fact, it certainly would be greatly to the advantage of many stations having a uniform rate of charge if they were to disconnect some of their large short-hour consumers instead of increasing their capital in order to extend their plant.

A perfect answer to these short-hour consumers, who object to pay a higher rate than their long-hour neighbors, is that under no circumstances whatever ought their supply to involve a loss to the supply company or increase the charge on the more profitable classes, as it is obviously very sound commercial practice in every business, without exception, to encourage the profitable, even at the risk of losing some of the profitless business.

American central station managers were among the first to recognize that the cost of supplying a given quantity of electricity depends in nearly every case, far more on the time over which the supply is spread than on the quantity taken, and early saw the commercial unsoundness of indiscriminately supplying all consumers at the same fixed rate per lamp-hour or kilowatt-hour, regardless of the varying lengths of time over which the supply was spread; but they, with many others, have been deterred from changing their method of charging by the doubt as to whether a more equitable one could be successfully carried out in practice.

If it be theoretically sound that the cost of supplying electricity generally depends chiefly on the length of time the necessary plant and mains are used, it seems an obvious corollary that the charge for the supply should conform to the same law. The author hopes to show that this theoretically correct principle can be successfully carried out in practice to the great advantage of both the supply stations and the general public. He moreover contends that it is impossible for a general supply to be given at so low an average cost or price on any uniform basis of charge as it can be on an equitable sliding-scale tariff, as a uniform price necessitates the long-hour, or profit-yielding, consumers having to make up to the company the loss incurred in supplying the short-hour consumers; this must tend very greatly to limit the use of electricity by the long-hour consumers, and, further, to bring to the station a large and undesirable class, who are thereby enabled to get their supply at less than its cost, and surely means placing quite an unnecessary and unwise limit to the lowering of the price at which electricity can be profitably supplied.

If the principle of a sliding scale, based upon the more or less prolonged use of the maximum demand is correct, then, on every consideration of practice and of policy, it should be applied to each consumer without distinction.

Uniform rates mean that, if high, they discourage

the only class of business yielding profit; and if low, mean a heavy loss on supplying short-hour consumers, which they directly encourage. Moreover, a uniform rate can never be so low for the supply of electricity to long-hour consumers as charges on an equitable sliding-scale system.

The author hopes to prove, by the figures given later, that a uniform charge for electricity limits its use to the classes, and that it is only by the system of making the charges follow the same law as the costs that the masses can be reached. This limiting of the use of electricity to the select few is still more aggravated by the prevalent, but highly pernicious, system of only giving substantial discounts to large consumers, irrespective of their manner of consumption.

One would think, to judge from the load curves of many of the central stations, charging on the uniform-price system and giving discounts in proportion to the amount of the consumer's bill, that nine-tenths of the population went to bed about eight o'clock in the evening, or, in any case, did not require artificial light after that hour; yet the amount of light acquired from then until 11 or 12 p. m. must be immense, and, being a prolonged load on the central station, would be taken under the most favorable conditions for cheap supply. As a matter of fact, in such towns it will be generally found that consumers pay two lighting bills—one for electricity, which, by reason of the high uniform rate of charge, only is used in the short-hour lamps in conspicuous places, and another for gas or other illuminants, which are used in the long-hour burners, by reason of their lower price—yet the actual conditions under which these different lights are produced and supplied favor quite the reverse.

It is important to bear in mind that gas is considered good enough in a considerable proportion of the situations where artificial light is required, and competition with it, in such positions, must be on the basis of cost. The public freely admits that electric lighting is necessary for living rooms, offices, shops, theaters and restaurants, but with electrical energy at a uniform price, or other form of restrictive tariff, it is apt to remain satisfied with gas in corridors, kitchens, bedrooms, girls' workrooms, etc.

Although there are very few men who, having studied the question of the cost of supplying electricity, will now deny that this has to be provided and delivered under essentially different conditions from those appertaining to the supply of commodities, such as gas and water, yet it is not by any means so generally recognized as the author thinks it must ultimately be, if the use of electricity is to become equally general, that these great differences in the methods of production and supply are so radical that they necessitate entirely different methods of charge.

Taking the cases of gas and electricity supply, in the former, owing to the low cost and efficiency of gas storage reservoirs, it may be taken as nearly correct that one consumer taking the same quantity of gas per annum that another does, but at quite a different maximum rate, will cost the gas company practically the same amount; whereas, with electricity, owing to the greater cost of, and unavoidable loss in, storage batteries, compared to the cost of a boiler and stream dynamo plant of equal maximum output, it can be shown that a kilowatt-hour, consumed in, say, half an hour, may quite possibly cost the company nearly 10 times as much as if the same consumption had been spread over 10 hours in the same day, owing to the capital outlay and standing charges being so enormously greater in the first case compared with the second. Now the author challenges anyone to prove that it can be either equitable or even commercially expedient to charge for these two equal quantities of electricity at the same rate per kilowatt-hour. Moreover, he asserts most emphatically that, unless the charges for these equal quantities vary in about the same ratio as their respective costs, the supply companies are seriously discouraging their very best consumers and actively encouraging the most undesirable class they can have, and so long as the many-hour user of light is expected to pay the cost of keeping plant standing idle for other people, so long will he stick to gas if he is in a small way, or prefer an isolated plant if he is wealthy.

DISCOUNTS ON CONSUMPTION PER LAMP FIXED.

It may be said that all this is very much like thrashing a dead donkey, as many managers have long ago introduced the system of giving discounts in proportion to the number of lamp-hours consumed per lamp fixed per annum. However, the author's contention is that, although this is an honest attempt to solve the difficulty, the counting of the lamps and estimating their current-consuming capacity is only applicable to those stations that cater merely for street or similar lighting.

The author maintains that, for anything else than street lighting, this system must have a very pernicious effect on the development and extension of the supply business, for the following reasons:

Firstly, as the discount given is frequently inversely as the connected load (a strange method surely of encouraging the public to give a whole-hearted support to electric lighting), a consumer usually installs only those lamps he can use very freely, and, under this scale, the longer he runs them the larger will be his bounty in the shape of discounts; as he knows very well that if he fixes any less frequently used lights, his consumption per lamp, and, consequently, the discount given him, will decrease, so he stops short of the number he would like to use, and electric lighting remains for him a luxury strictly confined between the limits of certain business or social requirements.

The economic disadvantage of this method of charging, then, is that it tends to contract the load curve and drive up the peak, which seem to the author fatal to this system. This restriction of the use of electricity must prevent the consumer's individual load curve being broadened out by the use of lamps that, although not used for many hours daily, yet are used at a time when many of the others are extinguished. It is obvious that the more generally a building is wired the more natural is it that a prolonged demand for current from the supply station should result. In domestic lighting and in competition with isolated plant supply, giving discounts only on lamps actually fixed, is prohibitive; a domestic supply of light is very imperfect unless it can be had when and where required, and in both of these cases it seldom happens that anything like all the lamps are required to be lighted simultaneously. By this method of discounts, hotels and private residences, which afford probably the most profitable field for electricity supply, would be charged at a rate so high as to prohibit the general wiring of them, although, by their being generally wired, their load curves would be so spread out as to make them highly desirable consumers. This method of giving rebates must also prevent large business establishments from wiring their entire premises, although, probably, the lights would be used in the upper residential parts when those on the lower floors have been extinguished.

The second objection is that in practice the author maintains it is impossible, in a large business, to ascertain with sufficient accuracy throughout the year the wired capacity of all the consumers' premises. This is patent when we remember the largely varying capacity of lamps, the natural desire and unobjectionable habit of consumers changing the candle power of their lamps to suit their varying requirements, and the temptation this system offers to fraud; furthermore, it is no more equitable to estimate a consumer's actual demand from his wired capacity than it is to rate a motor at its maximum possible output, irrespective of its actual current requirements.

The third great objection is the inexpediency and great expense of insisting upon the necessary domiciliary visits in all parts of private houses, hotels, etc., which this system requires. These visits are not only highly objectionable, so far as the consumers are concerned, by reason of the intrusion into the privacy of every part of the building, but, from the company's point of view, the expense entailed is very large, as the visits, to be of any use, must be frequent, and the time expended in counting lamps and noting their candle power is very serious.

In one way or another the public has tolerated a good deal from electrical men—roof fixtures, for example—but the author's own experience has led him to the conviction that the best policy is to give a good and steady supply on an encouraging tariff, to draw the revenue in due season, and otherwise trouble consumers as little as possible. The author cannot think there is any finality in a tariff which makes it necessary for anyone to intrude on the privacy of a man's premises for the purpose of checking his connected load.

Such a system, to put it mildly, leaves room for considerable inconvenience to both parties, and, as we elect to call electrical engineering a tolerably exact science nowadays, I think the time for domiciliary visits has gone by, as we can get all of the necessary figures in the neighborhood of the meter by the use of a suitable instrument.

Finally, no one can pretend to say that there is any real connection between the cost of supplying a large establishment, such as a hotel, and the scheduled number of lamps installed.

Fortunately, there is a much cheaper way of determining the consumers' true demand on the station for supply, and consequently the true basis on which the charges should be made, viz., by measuring the greatest rate at which they usually require to be supplied with electricity.

Another system now very much in vogue, but having equally bad effects in preventing the profitable development of supply stations, is the unsound practice of charging a higher price for electricity consumed in lamps than in motors or other current-consuming apparatus, thus implying, for some reason, that the consumer who requires the use of the station generating plant at night should be debited with the whole of the standing charges incidental to keeping this plant ready, although the same plant may be equally used in the daytime to supply another consumer's motor. Surely both of these consumers ought, in common fairness, to share these necessary costs of keeping this plant ready. For a reductio ad absurdum of this practice, we have only to compare the relative profitableness of a basement user of lamps with that of an elevator motor, the former being the steadiest and longest consumer any manager can desire to have, and the latter the most objectionable kind of short-time user of electricity.

THE ISOLATED PLANT QUESTION.

In the author's opinion, one of the most profitable fields for extension lies in the displacement of isolated plants, which to-day are frequently a curse to the supply stations by requiring connections to the company's mains as a stand-by against accidents.

This practice forms one of the strongest reasons the author can quote for the necessity of charging each consumer the cost, as nearly as possible, of keeping a proportion of the plant and mains ready to supply him, just as much as it is necessary to make him pay in proportion to the quantity of electricity he consumes. The author maintains that the isolated plant question can, by a judicious tariff, be turned into a blessing, instead of a curse, and his experience leads him to believe that there should be little difficulty in obtaining practically the whole of the profitable part of this business as regular consumers, instead of irregular worries. By no other method than that of an equitable sliding scale can this particular and generally very profitable business be obtained. It is well known that isolated plants are generally only installed where the demand for electricity is of a lengthy nature, consequently they would form a most desirable class of consumers if their permanent supply could only be obtained.

That the result of an equitable sliding scale is to get this class of consumer on a central station supply, is shown in Brighton, England, where, since the sliding scale has been adopted, several valuable isolated plants have been secured to the supply station mains, and not a single new one has been installed in that town.

What is there fundamental in the organism of a central station which should enable it to furnish a block with electrical energy more favorably than can be done by means of an isolated plant? Clearly it is the diversity of the duty which may be performed by the central station.

The cost of a plant supplying a few premises whose requirements make their individual load diagrams pretty closely coincide, must clearly be higher than those of a station catering for a wide variety of demand, and the more diverse this demand in point of time, the greater the output of electrical energy for a given expenditure.

VALUE TO SUPPLY COMPANY OF VARIED CLASSES OF CONSUMERS.

Another excellent method of profitably extending the business of central supply stations, is catering for, as much as possible, different classes of consumers requiring electricity at varying hours, and on the same principle encouraging consumers to install lamps that will be used at different times of the day and night. This diverse supply in a town obviously means a much less plant capacity than would be the case were all the lamps required for the same purpose and at the same time. As an illustration it is only necessary to quote the two cases of a large, early-closing store and a theater, or, as applied to the individual consumer, the public rooms and bedrooms of a hotel. In these cases the plant required to supply the store and theater, or the hotel as a whole, would be generally much less than the sum of the requirements of the two classes. In the town of Brighton, where the actual demands of all the consumers are accurately known, and where the use of electricity is very evenly divided between residences and stores, this diversity factor is nown no less than 1½; or, in other words, if all the Brighton consumers were to require, simultaneously, their ordinary maximum supply (not their wired capacity), the generating plant of the station would have to be increased very nearly 50 per cent.

The consumers have a community of interests in flattening out the station load curve, and they are bound to do it on a tariff that encourages them to wire their premises throughout.

BEST DIRECTIONS FOR ADDITIONAL CAPITAL OUTLAY.

The importance of considering in which direction any additional capital of a supply company can be best spent, is also worthy of special study.

In the author's opinion, it is very much more important to run, very soon after the starting of the station, mains in all districts of the town in which artificial light is used late in the evening, although this may be in the districts of the poorer classes of consumers, than it is to spend it on coal-saving refinements, or in running large mains in districts occupied by immense early-closing stores or by the mansions of the wealthy; both classes being very expensive to supply, because of the short daily use made of the plant by the former, and the latter's frequent and lengthy absences from home, or the erratic nature of their demand.

The author would specially point out the true economy of a liberal supply of distributing mains, which can be made to serve the double purpose of supplying the street lamps as well as the general public. In this connection he questions very seriously the wisdom of the practice, resorted to by many central station managers, of running special mains and systems for the sole supply of the public street lamps, as by so doing they needlessly increase the total cost of supplying the whole of the requirements of the district.

The author thinks that insisting on a high initial rate of charge per kilowatt-hour, or lamp-hour, being maintained to each consumer until the annual cost of getting the plant in readiness to supply his maximum wants has been covered, and then substantially reducing the charge for the subsequent consumption, forms the basis of a perfectly equitable tariff, applicable to all stations and conditions of supply.

CORRESPONDENCE.

New York Notes.

New York, August 3.—The first direct result of the recent decision in the Vandepoele case was the action of Judge Lacombe of the United States Circuit Court entering orders vacating the injunctions which have prevented the Union Railway company of this city and the New York, Elmsford and White Plains Railway company from using trolley pole devices. Judge Lacombe based his action upon the decision of the United States Circuit Court of Appeals, handed down on July 21st, dismissing a similar injunction in the case of the Thomson-Houston Electric company against the Hoosick Railroad company.

Gen. Collis has given a permit to the Metropolitan Street Railway company to change the motive power of the Fourth avenue surface road from horses to electricity from the southern end of Center street to the extreme northern end of the line in Harlem. Decision on the application to continue the change of power from the southern end of Center street to the terminus of the road at Broadway, has been reserved until the protest of the Third Avenue has received further consideration. The officers of the Third Avenue object to a change of motive power on the Fourth Avenue line along Park Row because, they say, one track is theirs. No practical scheme can be evolved whereby electric and cable companies can use the same conduit.

Municipal ownership of street railways is promised as a factor in the approaching charter elections. The Progressive Democratic League has taken up the matter. A member of that organization explained that "the main object now is to force into the campaign the issue of municipal ownership and the operation of all municipal franchises. The city owns the franchises now. We shall insist, on the lines of the Chicago platform, that it shall operate them. We are going ahead with our conferences with the other clubs and are organizing thoroughly everywhere, so that we will be in a position, if Tammany Hall does not reaffirm the Chicago platform and does not adopt herself a plank for the operation of franchises, to perfect our organization in every district, and to constitute ourselves the regular democratic party of the city of New York." It is suggested that the true reason of the withdrawal of Messrs. Whitney and Flower from the democratic party was fear of the position it might assume on this subject.

The Caracas Electric Light, Heat and Power company was incorporated at Trenton, N. J., July 28th, with a capital stock of $1,000,000, to be fully paid up when business is begun. The company will build and operate electric plants and a railroad in Venezuela and other South American countries. John E. McEwan of Brooklyn, Charles C. Drew of New Brighton, S. I., and Robert Weinmann of Jersey City are incorporators.

Elizabeth was visited on July 28th by the most severe storm known in that city in 20 years. The flood practically separated the city into two parts, one of which, the northern, was deprived of service by the fire department and trolley cars, and was virtually isolated. The plant of the Suburban Electric company, which supplies the electric lights for Elizabeth, Roselle, Cranford and Westfield, is located on the bank of the river on Murray street. The water reached the boiler room at eight o'clock, and at 9:30 put out the fires. The electric lights throughout the city went out and left the city in darkness. Trolley car traffic was suspended about nine o'clock. The cars had not been running over the entire route for several hours.

Fire caused considerable damage in the Excelsior Electric company's four-storied building fronting on Willoughby street, between Navy and Raymond streets, Brooklyn, July 27th. The company carries a large stock of dynamos and other electrical supplies, and they were much damaged by water.

Four street railroad companies were incorporated with the secretary of state at Albany on July 28th, having the same interests behind them. The roads are to be constructed in Greene, Albany and Schoharie counties, to be operated by electricity and to carry passengers, express and freight. The first company is the Coxsackie and Greenville Traction company, to operate a road from the terminus of the Green County Traction company's line in Coxsackie to Greenville and Durham, a distance of 12 miles. The capital stock is $150,000. The second is the Oak Hill Traction company, to construct a road 20 miles long from the above terminus to Oak Hill, Conesville, Cooksburg, Rensselaerville, East Durham and Cairo, in Green county. It is capitalized at $250,000. The Middleburg and Oak Hill Traction company is the name of the third company, formed to connect with the last named road near Rensselaerville, Greene county, running thence to Rensselaerville, Albany county, to and through Broome and Middleburg, Schoharie county, a distance of 25 miles. The capital stock is $300,000. The name of the fourth is the Windham Traction company, formed to connect with the second named company near Durham, thence to run to Conesville, Manor Hill, the towns of Windham and Ashland, and the villages of Harrisonville and East Windham, to a point near Butt's hotel, in Durham, a distance of 20 miles. The capital stock is $250,000. The directors of these companies are: W. G. Raines, T. E. Smith, W. F. Leland, W. S. Smith, M. E. Ingersoll, P. Anderson, E. Richter and Albert A. Lasson of New York and George C. Spencer of Chicago. The principal office of these companies will be in New York, and T. E. Smith of New York subscribes for a majority of the capital stock of each corporation. These companies do not have to pay the incorporation tax required until the State Railroad Commission consents to the construction of the roads. The Greene County Traction company of Coxsackie is the name of a company incorporated some time ago by these interests and with which the four companies organized to-day are to connect. The Greene County Traction company has already applied to the State Railroad Commission for permission to construct its road, and the commission will give a hearing on the application in New York on August 11th. It is proposed by the operation of these roads to open up a fertile section not now accessible by rail through Greene and Schoharie counties and a portion of Albany county, and to maintain these roads as a feeder for the West Shore railroad at Coxsackie.

The fleet of warships anchored off Tompkinsville, Staten Island, last week, drilled with their electric signal and flash lights. The spectacle was witnessed by hundreds of people along the Staten Island shore. The signals could also be seen from the Brooklyn water front, from Fort Hamilton to Governor's Island, and from the Battery. The first drill was with the electric signal lights, and the rapidly changing colors of the lights presented a pretty picture. When this drill was over the searchlights were set at work, and their combined light illuminated the bay in a dazzling manner. They were thrown upon Staten Island, and several prominent points were picked out by them. The wharves along Staten Island were carefully searched, and then the lights were thrown upon the forts at the Narrows. Then the entire battery of lights was trained upon the Statue of Liberty. The figure could be seen far clearer from Staten Island than it can be by daylight. The next drill was the searching for and following the movements of steamers moving about the bay. In this way all the lights were used, each light having a certain area to cover. The wreck of the Ailsa at Fort Hamilton was also illuminated with the searchlight.

PERSONAL.

General Manager Kuhlman of the Kuhlman Electric company of Elkhart, Ind., was a visitor at the office of the Western Electrician last week.

The Hon. George S. Hale of Boston, who died suddenly at his cottage at Bar Harbor recently, was the father of R. S. Hale of Boston, known to many of the electrical fraternity.

Electrical Contractor Harry S. Smith of 14 South Broad street, Philadelphia, visited Chicago last week in the interest of the Scott and Janney Electric Manufacturing company. Mr. Smith expects to return to New York after a short stay in Chicago.

General Manager A. H. Patterson of the Phœnix Glass company of New York has been a visitor in Chicago during the last week. He reports that business is better at present than it has been for the last year, and that the outlook generally is very favorable.

Charles T. Yerkes may soon retire from the presidency of the West Chicago Street Railroad company. This statement has been printed each year for the last six years just before the annual meeting, but this time the story of his probable retirement is received with a little more credence than formerly, because of the source from which the story emanates. The reason given for the probable retirement of Mr. Yerkes from West Chicago is that he desires to spend more of his time in New York than he has been doing, and West Chicago requires the constant attention of an executive to keep its complex affairs in shape. Mr. Yerkes, it is said, will keep the presidency of the North Chicago Street railroad, which, it is explained, will almost run itself, spending a few days each month in Chicago and transacting the ordinary business that will go to him from New York. If Mr. Yerkes ceases to be president of West Chicago it will not mean that he is giving up his interest in that corporation. There are three names mentioned as Mr. Yerkes' probable successor—D. H. Louderback of Chicago, W. L. Elkins and P. A. B. Widener of Philadelphia.

W. L. Arnold has severed his connection with the General Electric company, with which he has been associated for the past seven years, to accept the business mangement of the Arnold Electric Power Station company of Chicago. Upon leaving college Mr. Arnold began commercial life, and prior to entering the electrical field was in the retail shoe business in Minneapolis, Minn. In July, 1889, he took a position with the Excelsior Electric company, representing it at St. Louis, Mo., until May, 1890, when he was given the position of manager of the St. Louis office of the Thomson-Houston Electric company, and continued in that capacity after the consolidation of the Thomson-Houston and Edison General Electric companies, and represented the General Electric company as manager at St. Louis until June 1, 1895, when he was transferred to the Kansas City office, which he managed until June 1, 1896. From Kansas City Mr. Arnold was called to the Chicago office, where he has been associated until the present time in the capacity of a special agent in the apparatus department. His connection with the General Electric company has been successful and pleasant, and he leaves it with the best wishes of his associates and the company for his success in his new undertaking.

ELECTRIC LIGHTING.

Fayetteville, N. C., has voted to bond the town to the amount of $15,000 for a system of electric lighting.

City Electrician Ellicott of Chicago announces that he contemplates extending the street lighting system on West Adams and West Monroe streets between Canal street and Center avenue. Thirty new lights will be put in this district.

The municipality of Munich has decided to erect an electric lighting station. The city electrical engineer has designed a station of 4,250 kilowatts capacity, generating current at 5,000 volts pressure, and a number of sub-stations, in which the pressure is to be reduced for lighting and power. The initial outlay is estimated at $2,000,000, to be increased later to $2,750,000. There are already 206 private installations in Munich, which include 63,000 incandescent lamps and 2,000 arc lamps. From replies to circulars issued, the demand has been estimated at an 8,000 kilowatt lamp connection. Three-phase current is to be used to facilitate the use of power in factories.

A suit to recover $500,000 damages was begun in the Common Pleas, July 31st, by James Madden and other stockholders of the Penn Electric Light company against John Lowber Welsh, Thomas Dolan, William Wood, Richard Brock, Clement B. Newbold, George W. Hill, John Boyd and A. J. De Camp, alleged partners in the electric trust, which for six years, it is charged, controlled an illegal monopoly of the public lighting in the most important territory of Philadelphia during that period. The property and franchises of the Penn Electric company, it is alleged, were depreciated in value by the fraudulent practices of the defendants, who controlled a majority of the stock. A. J. De Camp was made president of the Penn, and during his executive management, the bill charges, an agreement was maintained with the Edison Electric Light company by which the latter company controlled a monopoly of the city lighting to the prejudice of the Penn, whose rights and privileges as competitor were suffered to lapse into disuse.

ELECTRIC RAILWAYS.

Charles Green, president and receiver of the People's Railway company and the Fourth street and Arsenal line, St. Louis, is reported to have promised that the Fourth street and Arsenal line will be a "three-cent fare line."

Construction work has been begun on the extension of the Bluff City electric street railway from Waukegan, Ill., to Evanston. Ground has been broken at a point north of Wilmette, where the line runs along the west side of the Chicago and Northwestern railroad. At Winnetka it crosses to the east side of that road, and continues up to North Chicago.

Dr. Lueger, the anti-Semitic mayor, declared that he hated the Vienna tramway, as being a Jewish undertaking, and since then not a single proposition could the company make but the Municipal Council rejected it. The new syndicate which has now secured control is said to have the German Bank and Siemens & Halske at its head, and it is supposed that the motive power will be changed to electricity.

The Lake Forest (Ill.) Town Council has granted a franchise to the Bluff City Electric Railway company to build and operate an overhead trolley railway in Depot avenue through the town. As the consents of the villages of Lake Bluff, Fort Sheridan, Highwood and Highland Park have been obtained, the company is now free to extend its line. The section between Fort Sheridan and Highland Park will be built first.

The management of the Chicago General Railway company has practically completed arrangements for placing a large block of the company's bonds. The agreement recently reached between the City Railway and the Chicago General concerning the Twenty-second street line has created an impression that the bonds are to be taken by the City Railway people. It is understood the bonds will be sold at about 90. This is a much better price than could have been had previous to the settlement with the City railway. The Chicago General bonds are five per cents., due in 1835. The authorized issue is $3,000,000, and $1,300,000 has already been issued.

The Milwaukee Electric Railway and Light company has completed negotiations for control of the Waukesha Beach electric road, running from Waukesha to Pewaukee lake. This road will be extended to Oconomowoc and other resorts in Waukesha county the present year. Henry C. Payne said it was the intention of the Milwaukee company to extend its lines to Waukesha to connect with the Beach line, and that the road to Waukesha and the connections of the new system would be ready for operation before July of next year. The City Council of Waukesha voted unanimously, July 28th, to

grant a franchise to the Waukesha Electric Railway company, the stockholders in which are the same as those in the Milwaukee Electric Railway and Light company. The price paid for the Waukesha Beach line is said to have been $65,000. The road will be transferred subject to a mortgage for $50,000. The original cost of the road was $106,000.

Judge Kirkpatrick of the United States Circuit Court at Trenton, N. J., on July 21st set aside a $75,000 bond issue made by the Asbury Park & Belmar Street Railroad company, on the ground that it was fraudulently executed. The company is now in the hands of a receiver, and the suit testing the validity of the bond issue was brought by Adrian Vanderveer, trustee under a mortgage. Judge Kirkpatrick says that any bonds held by innocent parties, who hold them for money paid, will be declared valid. The company was organized under a law which requires that its capital stock shall be not less than $10,000 for each mile of road to be built; that at least 50 per cent. of the capital stock shall be paid up in cash before the work of construction is begun; that before the work is begun all the capital stock must be shown to have been subscribed for by responsible persons, and that no issue of bonds may be made by the company until the full amount of the capital stock is shown to have been expended in the building of the road. The company was organized to build a trolley line two miles long to connect lines running to Long Branch and Belmar. The capital stock of the company is $75,000. After the company was formed the stock was duly subscribed for, but not a dollar was ever received by the treasurer of the company in return for the stock issued, although a check for $30,000 was tendered him. This check was never presented for payment, but was subsequently returned to the maker, Mr. Aldrich, one of the directors. Judge Kirkpatrick says that this check was a mere ruse, designed as a salve for the conscience of the officers of the road. Upon the strength of it the affidavits were made that half the stock had been paid for in cash when the construction of the road began. The contract for building the road was awarded to T. B. Wilson, the price to be paid being 690 of the 750 shares of capital stock and all of the $75,000 bond issue. Judge Kirkpatrick says that Wilson was a mere dummy in the matter, and that the work was really to be done by the directors, who were to receive all the benefits from the transaction. The directors were George Aldrich, George Potts, L. E. Watson and Thomas Bullock. Judge Kirkpatrick says that these methods are clearly fraudulent and illegal and that the entire road could easily have been built for much less than the amount of the capital. From this fact alone he considers it sufficiently evident that the law had not been complied with and that the bond issue was invalid.

TELEPHONE.

The earnings of the Chicago Telephone company for the first six months this year are said to have shown a good increase over those of the same period in 1896, and this showing probably accounts for the recent heavy advance in the company's stock. The company has decided to make some improvements, but the sum to be expended will not be large, and is now in the treasury of the company.

All the men employed as night operators in Boston and the suburban offices of the New England Telegraph and Telephone company have been notified by Superintendent Fiske that their services are not required. Their places are taken by young women. Complaints had been numerous of incivility on the part of the "hello" men, and the company settled the matter by discharging the entire force of 30 men.

Announcement is made that the control of the Newark Telephone company has passed into the hands of a syndicate of New Jersey capitalists said to be composed of United States Senator James Smith, B. M. Shanley, James F. Connolly and E. B. Gaddis of Newark and Thomas Nevins of Orange. The syndicate, it is said, has agreed to put in $150,000 cash, take up all the unsubscribed stock, and complete the work of construction, so as to have 2,200 telephones in operation by December 1st. The Newark Telephone company was organized a little over a year ago with the avowed intention of fighting the Bell company. Several months ago suit was brought in the Chancery Court at Jersey City for the appointment of a receiver, upon the allegation that the company was insolvent, but this prayer was denied. Afterward an action was begun by an equipment company of Philadelphia against the New York Telephone and Telegraph Construction company, which built the telephone company's subways. This suit, which is still pending, and the other, were supposed to be in the interests of the Bell people. It was rumored that the transfer was in the same interest, but this President John M. Gwinnell denied.

A circular issued by Robert Mellors, secretary of the Association of Trade Protection Societies of Great Britain, and dated Nottingham, July 15th, contains a statement with regard to the telephone service, together with a letter received by Mr. Mellors from the postmaster-general in reply to a letter forwarding a copy of a resolution adopted at the forty-ninth annual meeting of the association. The resolution pointed out that the difficulties connected with telephonic communication were a serious impediment to business, and the hope was expressed that the postmaster-general would speedily provide increased telephonic lines, while a desire was also expressed for the hire of telephonic instruments at less cost than that now charged. In the course of the statement given in the circular, the high annual rents charged in England for telephonic instruments were contrasted with the rates prevailing on the Continent. It is considered reasonable, owing to various circumstances, that a higher price should prevail in England than in some other countries; but it is submitted that the present rent charge is excessive, and that the service would pay quite as well at reduced rates, by the probable increase in the number of subscribers. Thus, Stockholm, with a rent of £2 16s. for government telephones and £4 9s. for privately owned telephones, and a population of 200,000, has 20,000 telephones; Nottingham, with telephone rents very much higher, and with a population of 240,000, has 1,350 instruments. It is further pointed out that the system of charging by distance has been abolished in letter carriage and with telegrams, but has been adopted with the telephonic service for reasons not obvious. What is wanted is a larger extension of the telephonic service, at uniform rates and cheaper rents. The postmaster-general's reply, dated July 10th, to the association, is to the effect that a very large number of additional trunk lines, have either been recently completed or are in course of construction, and that the service is now satisfactory, except in a few cases where difficulties have prevented the erection of additional trunk lines with such speed as could be wished. If, however, any particular case is specified by the association in which the trunk wire accommodation appears to be inadequate, the postmaster-general will be glad to consider the matter. As regards the question of charges for the hire of telephonic instruments, the government "is giving careful consideration to the whole question, and will be glad if it should find it possible to meet the wishes expressed in the resolution."

MISCELLANEOUS.

Charles Kinkele, proprietor of the Lake Shore hotel, Walker, Cass county, Minn., is in the market for about 30 miles of small telephone wire.

Business will be practically suspended in electrical circles throughout the East on August 21st, that being the date set for the nineteenth annual Rhode Island clam dinner tendered to the electrical fraternity by Eugene F. Phillips, president of the American Electrical Works of Providence. The scene of festivities will be the Pomham club, and it is needless to say that everybody of consequence in the electrical world will be there. Mr. Phillips knows how to make these annual gatherings attractive, and those who have once enjoyed the hospitality of Pomham are ever afterward constant and enthusiastic friends of Mr. Phillips, the American Electrical Works and everybody and everything in which they are interested.

Electric pacing is popular in France. Recently on the Seine track at Paris an electric triplet received a trial and traveled five miles in 7 minutes 42 2-5 seconds. The tubing on the machine differs from the regular triplet, inasmuch as it is necessary to carry 28 boxes of accumulators. Each box contains 13 plates 75 millimeters wide and 115 high, weighing in all about 84 kilograms. The accumulators furnish current to a small electric motor of three horse power, which adds to the efforts made by the riders. The motor by a chain system works on the rear wheel, taking the place of a fourth rider. The machine is made to run at a speed of 66 kilometers an hour. A modification of its construction is contemplated to increase its rate of speed.

TECHNICAL SCHOOLS.

The announcements of the evening college conducted during the winter by the central department of the Young Men's Christian association, are now out and ready for distribution. The college this year will have 27 instructors, and will offer over 40 different branches of study. Among other things, classes will be formed in arithmetic, algebra, mechanics, free-hand, architectural and mechanical drawing, machine design, physics, chemistry, steam engineering, electricity and electrical practice. The work in electricity is divided into two parts, elementary and advanced. The elementary class will take up the work as laid out in Houston & Kennelly's electrical engineering leaflets, covering the fundamental theory of every-day electrical phenomena, while the advanced class will take up the use of electrical measuring instrument, the methods of making tests, the working of practical problems and the study of the questions involved in the construction and attendance of electric plants and apparatus. The classes are intended for electricians, engineers, wiremen, clerks, electrical workers, or anyone wishing to become more intelligent in a practical way upon the subject of electricity. The electrical classes this year will again be in charge of Geo. A. Damon, while Charles W. Naylor will look after the class in steam engineering.

TRADE NEWS.

The Electric Arc Light company of 687 Broadway, New York, manufacturer of the "Pioneer" 150 hour inclosed arc lamp, continues to report the booking of satisfactory orders, a very large one of which is for the installation at the Seventh Regiment Armory of New York city. This contract was awarded after a very severe test.

J. M. Knox and J. B. Farrington of the Varley Duplex Magnet company of Jersey City have been spending several days in Chicago calling upon the trade in relation to the company's well-known product. They report that the results attained have been far beyond their anticipations, so much so, indeed, that they have concluded to extend their trip to other points in the West.

A. J. McLean of Menominee, Mich., dealer in poles for electric light, telephone, telegraph and electric railway companies, reports a prosperous business. Mr. McLean carries a large stock of assorted poles. Contractors and others desiring white cedar poles will do well to communicate with Mr. McLean, whose facilities for prompt shipments are unsurpassed.

The Pacific Electric company has obtained possession of a device called "the electrical trick," by which a piece of money can be made to disappear in the most mysterious manner, so that the spectator will fail to detect how it is done. The company employs it to advertise its shade lamps and dental lamps, and will be pleased to send one of these tricks to anyone who will write for it, inclosing four cents in stamps to cover cost of mailing.

The Mason Electric Equipment company, 1202 Fisher building, Chicago, states that its order-book proves conclusively that "prosperity" has arrived. During the last month a largely increased business has been done, and shipments of electric railway supplies have been made to all parts of the country. In the absence of W. R. Mason, who is now representing the Walker company in St. Louis, E. R. Mason is conducting the business in a manner that bids fair to give him decided prominence in the supply field.

The Consolidated Car Heating company of Albany, N. Y., announces that "the United States Circuit Court of Appeals for the second circuit, on Thursday, July 22d, rendered an elaborate and sweeping decision, reversing the decree of the United States Circuit Court, which had granted to the Dewey Electric Heating company an injunction against the Albany Railway company, to prevent the use of the Consolidated Car Heating company's temperature regulating switch in connection with an indicating device, as being an infringement of the ninth claim of the Dewey patent No. 464,247. The court holds that this claim is entirely void for want of patentable invention, and this decision finally settles the right of the Consolidated Car Heating company and its customers to use its temperature regulating switches with indicators as the save have been and are now constructed."

BUSINESS.

Judge Lacombe of the United States Circuit Court for the District of New York has handed down a decision in favor of the Jandus Electric company in its litigation with the Manhattan General Construction company. Another case of the same character is to be decided shortly by Judge Hammond, sitting at Toledo, Ohio.

The Point Marion Manufacturing company of 430 Fourth avenue, Pittsburg, is doing a larger business this year than ever. It handles poles for any work, manufactures cross-arms, white and yellow pine, oak and locust pins and brackets, poplar and hardwood moldings, and oak and locust iron pole tops. The company is running its factory at Point Marion, Pa., day and night, and is making arrangements to put a branch factory in the East. It is represented in Pittsburg by the Globe Manufacturers' Supply company of 42 River street.

The growing tendency among those who have given careful consideration to the subject of protective coverings for iron structural work, is to add some form of carbon to the red lead used, or to discard red lead altogether. This has caused the red lead manufacturers to issue pamphlets condemning the use of carbon, especially graphite. The Joseph Dixon Crucible company says that these statements of the red lead people have been so wide of the facts that it has made reply by issuing a pamphlet on the "Merits of Lead Paints and Dixon's Silica-graphite Paint Compound," which is well worth reading.

The Davis & Egan Machine Tool company, Cincinnati, Ohio, has purchased the extensive works formerly occupied by the W. S. Merrill Chemical company of Cincinnati, Ohio. The buildings are modern and massive, and adapted to the operation of heavy machinery. They have 103 feet front, five floors, with basement and sub-cellars, and a railroad frontage on two streets. The new purchasers are now making a complete installation of new engines,

boilers, generators, dynamos, etc., and will have when completed an up-to-date power plant. The new addition joins the present works of the Davis & Egan company, the purchase being necessitated by the rapidly expanding foreign trade.

The Dolgeville Electric Light and Power company of Dolgeville, N. Y., has contracted with the Westinghouse Electric and Manufacturing company, through the latter's Syracuse agency, G. W. Pulver & Co., for two 450 kilowatt two-phase alternating current generators, one 250 kilowatt rotary transformer, exciters and a large marble switchboard, together with a number of transformers for light and motor work. The generators will be connected direct to Victor turbines, running at 300 revolutions per minute, under 72 feet head. The rotary transformer will deliver direct current at 600 volts, for present direct-current motor service in use in various manufacturing establishments. Both light and power will be furnished. The alternating current generators are of 7,200 alternations.

ILLUSTRATED ELECTRICAL PATENT RECORD.

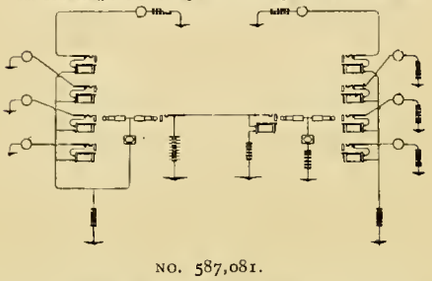
Issued July 27, 1897.

586,957. Brush-holder. Neal M. Beede, Schenectady, N. Y. Application filed May 5, 1897.

Carbon brushes are mounted in receptacles, spring-clips are secured to the brushes and flexible leads fastened to the clips; spring-clamps are secured to the leads, and lugs on the body of the brush holder for holding the clamps.

586,986. Electric Arc Light Reflector. Charles M. Bolles, Dallas, Tex. Application filed July 13, 1896.

The reflector is secured upon the lower edge of the annular band and extends inwardly therefrom, having an aperture for the passage for the arc light conductor, and means for securing the band upon an arc light cone.



NO. 587,081.

586,993. Telephone System. Gustaf Dilberg and Parnell Rabbidge, Sydney, New South Wales. Application filed September 9, 1895.

An induction coil having its primary and secondary coils in series in the speaking circuit, and an armature controlled by the induction coil to control the call-circuit, are described.

586,995. Form for Winding Coils for Dynamo-electric Machines. Henry Geisenhöner, Schenectady N. Y. Application filed March 16, 1897.

It is intended to provide means for giving the coil a shape while winding similar to the finished article, except for the offset in the ends; and, also, means for forming an offset in the ends of the coil.

587,002. Electrically Operated Locking Device for Elevators. Thomas W. Jenkins, Philadelphia, Pa. Application filed October 2, 1895.

A car with a power-controlling wheel and a door, a lock for the wheel, an electric circuit with a magnet controlling the lock, and contact points connected by the action of the door, are combined.

587,004. Telephone Exchange. Milo G. Kellogg, Chicago, Ill. Application filed June 15, 1895.

Multiple switchboards are divided into two sections, which are distinct and placed apart from each other over different floor space, an answering section containing the annunciators and switches of the lines whose calls are to be answered at the board, and a calling section containing two switches on which the operator may call and connect any line which she has answered, the calling sections being placed end to end and the answering sections each convenient to and in front of its calling section.

587,013. Telautograph. Leon O. McPherson, Highland Park, Ill. Application filed October 9, 1895.

Mechanism is provided for sending pulsations of successively alternate polarity for controlling the operation of a receiving pen, a reversing mechanism and a reversing relay in the circuit of the pulsations for controlling the operation of the reversing mechanism, the same being controlled by changes in the strength of the pulsations, and means whereby the action of the reversing relay is effected by changes in the rapidity of the succession of the pulsations.

587,014. Child's Cradle. Granville F. Packard, Fort Wayne, Ind. Application filed December 12, 1896.

Electricity is employed to give a swaying motion to the crib which is pivotally suspended and adapted for an oscillating movement. An electro-magnet is fixed to the frame and has an armature pivotally mounted in the frame of the electro-magnet in the path of oscillation, and connected in electrical circuit with the electro-magnet and adapted to accelerate the movement of the crib at each alternate oscillation thereof under the influence of the energized electro-magnet by the contact of the armature with a spring fixed to the crib or cradle when the electric circuit is closed.

587,015. Electric Meter. Granville F. Packard, Fort Wayne, Ind. Application filed May 6, 1897.

This instrument comprises an energizing coil or coils or field of force, a rotary armature of separable radial vanes rigidly connected on their supporting shaft or spindle by a pair of recessed and slotted disks interlocking therewith, the vanes being so arranged in inductive relation to the field as to be successively repelled therefrom; the clamping disks mounted on the shaft have their inner faces recessed to receive interlocking lugs on the vanes and are radially slotted, a speed-regulator comprising a slotted base is fixed on the shaft and one or more adjustable strips arranged therein, and a counting or registering train is connected with the armature.

587,047. Trolley Wheel Fork. Samuel B. Thompson, Baltimore, Md. Application filed December 2, 1896.

One of the prongs or supports for the axle is formed of a flat spring, the upper end of which presses against the hub of the trolley wheel, forming an electrical contact therewith, and its lower end is rigidly secured to the base of the fork.

587,062. Electric Bell. John T. O'Brien, Bridgeport, Conn. Application filed April 13, 1897.

There is the combination with a main circuit, a shunt circuit, a bell and an electro-magnet in the main circuit, of an armature in the shunt circuit carrying a striker and a contact, and a pin in the shunt circuit carrying an insulating block and a contact, the first contact being normally in contact with the insulating block, but being placed in engagement with the last contact, and thereby closing the shunt circuit by the movement of the armature to the magnet, which is caused by the closing of the main circuit.

587,073. Car Step. Albert Blum, Cincinnati, Ohio, Application filed August 3, 1896.

A swinging step mounted upon arms hinged to the car and adapted to swing horizontally into a position vertically beneath the stationary step or into a position vertically outside and below the stationary step, is controlled and operated electrically.

587,080. Calling Appliance for Telephone Switchboards. Frank R. McBerty, Downer's Grove, Ill. Application filed November 12, 1895.

Where telephone lines and a return circuit therefor have oppositely polarized signal bells in branches between each line conductor and the return circuit, and several pairs of connecting plugs for uniting different telephone lines, a key in each plug circuit is adapted to assume two positions, in one of which positions it severs the plug circuit and connects the operator's telephone with one of the plugs, and a pair of signaling conductors with the other plug, and a group of keys are connected with the signaling conductors, one adapted to send current of each polarity on each line conductor to operate a corresponding bell.

587,081. Telephone Exchange Apparatus. Frank R. McBerty, Downer's Grove, Ill. Application filed June 3, 1896.

A telephone line is grounded at two points subject to differences of potential, and is provided with a generator of alternating current at one sub-station and an annunciator at the other station, and a group of polarization cells in one of the ground branches.

587,114. Electric Condenser. Charles S. Bradley, Avon, N. Y. Application filed October 7, 1895.

An electric condenser having its pile of plates inclosed in a fluid, and air-tight metallic casing hermetically sealed at all joints, whereby the access of moisture in the outside air is prevented and the capacity is kept unaltered.

587,119. Telephony. John W. Gibboney. Lynn Mass. Application filed July 26, 1895.

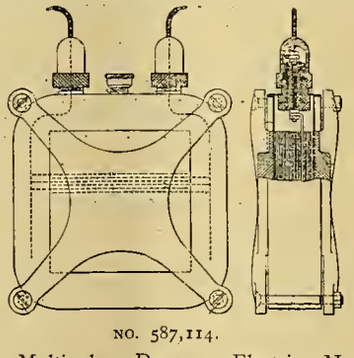
A generator is described for use in a telephonic transmitting system, comprising a stationary armature having substantially a continuous winding, and a revolving field magnet coil carried upon a shaft having reduced portions at each end making connection through mercury cups to a source of current connected to the cups, the shaft being divided into two portions electrically insulated from each other, and the field magnet coil having its terminals connected respectively to the shaft portions.

587,120. Telephony. John W. Gibboney. Lynn, Mass. Application filed August 3, 1896.

The improvement described in the art of electrically transmitting sound waves consists in generating alternating currents of relatively displaced phase, superposing upon one or more of such currents electrical undulations or vibrations corresponding to the sound vibrations to be transmitted, and by such superposed electrical undulations or variations actuating a suitable receiver.

587,143. Electric Programme Clock. Ernst Bobsien, and Sigimund L. Prager, Mount Vernon, N. Y. Application filed February 8, 1897.

This is an electric time signal clock with an auxiliary or index dial arranged below and visible through the opening in the main dial, there being suitable insulating means between the auxiliary and main dials, and a set of contact devices on the auxiliary dial.



NO. 587,114.

587,163. Multipolar Dynamo Electric Machine. Samuel W. Rushmore, Brooklyn, N. Y. Application filed February 23, 1897.

The machine contains an armature, several magnets arranged about the armature, and sets of brushes for separately collecting the currents generated in the parts of the armature under the different magnets independently of other sections, and connections from each set of brushes through the field coil of its magnet only.

587,164. Dynamo Electric Machine. Samuel W. Rushmore, Brooklyn, N. Y. Application filed May 14, 1897.

The method of operating a dynamo having a plurality of pairs of N and S poles consists in collecting current under but one pole only of each pair, using the second pole of each pair to keep the magnetic flux of its section from flowing to other sections.

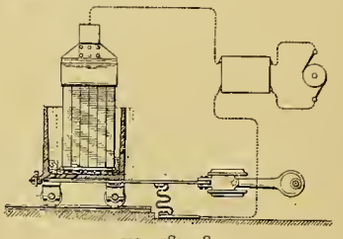
587,182. Electric Furnace. Guillaume de Chalmot, Leaksville, N. C. Application filed February 27, 1896.

There is a crucible or hollow hearth into which the carbon pencil may enter, and independent mechanism connected thereto for agitating or jarring the crucible in order to shake down the granular material fed thereto, and facilitate the feeding thereof into the arc.

587,204. Switchboard Annunciator. Newman H. Holland, Montreal, Canada. Application filed September 5, 1896.

An annunciator having an electro-magnet with a projecting core end, an armature, a shutter and a carrying-plate for the two latter, the projecting core end being annularly grooved and formed with lugs, and the carrying plate having an opening through which such lugs can be passed.

587,213. Conduit. Alvaro S. Krotz, Springfield, Ohio, William P. Allen, Chicago, Ill., and Oliver S. Kelly, Springfield, Ohio. Application filed May 28, 1896.



NO. 587,182.

The depth of one side of the contacting rail is greater than the other, and an insulating support is attached to the side of greater depth; there is a covering over the insulating support and over the contacting rail.

587,214. Trolley. Alvaro S. Krotz, Springfield, Ohio, William P. Allen, Chicago, Ill., and Oliver S. Kelly, Springfield, Ohio. Application filed June 16, 1896.

One claim is for a base, one or more flat-spring supports, a contact shoe attached to the free end of the spring supports, a conductor strip of high conductivity connecting the contact shoe and metal support or base and a stop.

587,216. Wire-holder. Joseph B. Lawrence, Salem, N. J. Application filed November 2, 1896.

The device consists of an upright standard having feet provided with openings, upwardly projecting arms having interior screw-threads, and an exteriorly screw-threaded insulator.

587,217. Fuse-holder and Electric Cut-out. Harry A. Lewis, Norristown, Pa. Application filed January 11, 1897.

A device of this class is provided with a circuit-breaker interposed in the line-wire, and a thermostat comprising a tube fixed at one end, and a line-wire passing through the tube to heat the same, an intermediate mechanism for connecting the tube with the circuit-breaker.

587,226. Telephone Trunk-circuit. Joseph J. O'Connell, Chicago, Ill. Application filed February 11, 1897.

A feature of the arrangement is a plug-seat switch, consisting of a seat for a plug, a casing inclosing two mechanically connected but insulated contact springs, one of which plays between two contact points and is provided with an extension into the plug-socket, a lever-connector adapted to be actuated by the movement of the other contact spring to reverse its position, the spring being adapted to make electrical contact with the lever.

587,237. Apparatus for Treating Diseases. Hercules Sanche, New Orleans, La. Application filed October 27, 1887.

The claim is given: The clinical instrument, comprising a contact plate or member adapted to be attached to the body to be treated, a second plate or member adapted to be placed in or under the influence of a temperature higher or lower than the body to which the other plate is attached, or under the influence of matter which is electro-positive or electro-negative to the body having said other plate or member attached to it, and a flexible conducting or transmitting medium connecting said two plates or members, said medium being of a relatively small size to said plates or members, and of a length sufficient to permit said two plates or members to be placed at such distances apart that the body having one plate or member attached thereto will be removed beyond the range of influence transmitted by direct radiation, conduction or contact from said other plate or member.

587,260. Circuit-closer. Steuhen C. Houghton, San Francisco, Cal. Application filed May 14, 1897.

A movable slide carries a pivoted contact arm, and there are a contact plate parallel with the slide, a spring tending to force the arm into contact with the plate, and a pivoted and spring pressed guard adapted to intercept and divert the arm away from the plate during its motion in one direction, but permitting it to make contact and retain such contact throughout the length of the plate during its motion in the opposite direction.

587,273. Insulator. Heinrich Rudolf, Berlin, Germany. Application filed October 14, 1896. Patented in Germany April 25, 1895, and in England January 24, 1896.

An insulator is described, consisting of a body portion having a head in which is formed a deep transverse groove, in the bottom of which is a cavity or recess adapted to receive a bend or loop in the wire or conductor, the head being also provided with a transverse perforation which passes through the cavity or recess, and a locking-bolt which passes through the perforation, and which holds the wire or conductor in place.

Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, AUGUST 14, 1897. No. 7

Buffalo Grain Elevator to be Electrically Operated.

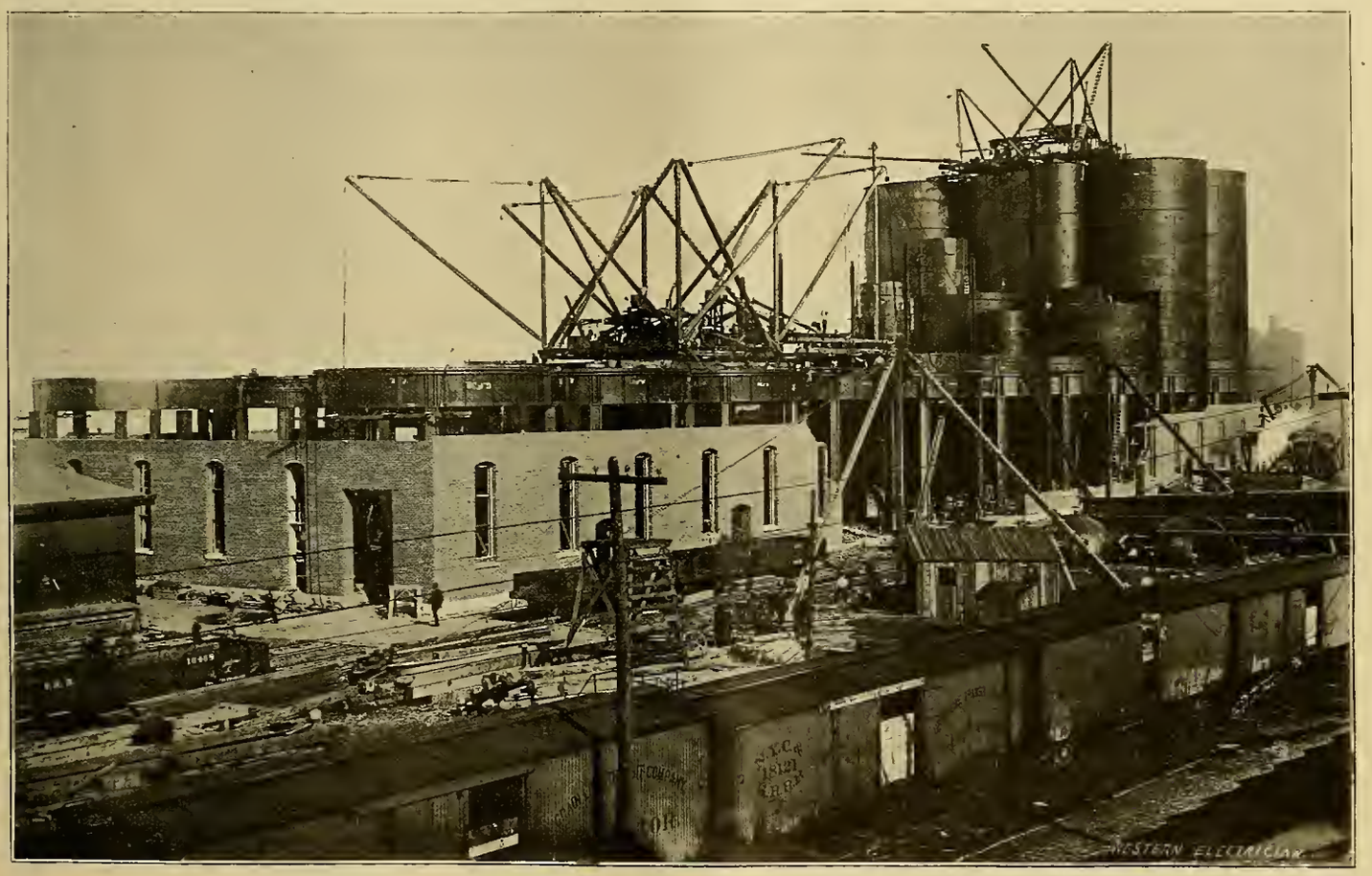
By Orrin E. Dunlap.

The Great Northern elevator that is being erected in Buffalo between Ganson street and the ship canal is to be one of the most modern structures of the kind, and is destined to attract considerable attention because of many novel features, the principal one of which is that it will be operated by transmitted electric power from Niagara Falls.

Still another feature is that the grain bins are to be great steel cylinders. In the illustration presented herewith, these steel cylinders are displayed in course of construction. The bins farthest to the right are shown at their full height. When all the bins are built they will be inclosed within brick walls, which will give the elevator building very much the appearance of other similar structures, and serve to conceal all the steel work. The elevator is being erected by James Hill, president of the Great Northern Steamship company. The capacity of the elevator will be 3,000,000 bushels. The illustration shows that there will be three rows of bins, and each row will have 10 bins, or 30 in all, each of which will have a capacity in the neighborhood of 100,000 bushels. The height of each bin is to be 84 feet, with a diameter of 38 feet.

The foundation of the elevator is laid at a depth of 50 feet, and on this foundation is built a steel structure, the columns on which the steel bins rest being about two feet square. This construction is clearly shown in the illustration. It will be noticed that between the rows of large bins are smaller bins, and it is into these small bins that the grain is put as it comes from the boats, being afterward elevated to the larger bins.

The electric power for the operation of the elevator will be furnished by the Cataract Power and Conduit company, the contract having been made some time ago. The plans for the electrical equipment are now being completed. The elevator will be ready for business next spring, in all likelihood. It will be the first of its kind in the world.



BUFFALO GRAIN ELEVATOR TO BE ELECTRICALLY OPERATED.

Improvement in Telephone Exchange Business.

Phenomenal appreciation in the value of telephone securities has been the subject of much comment recently. A couple of weeks ago, when Chicago Telephone sold at 200, 35 points above the last previous public quotations recorded about one month before, people wondered at the sudden advance. Much more astonishing is the increase in the value of Central Union. On August 10th, 28 shares of the stock sold at 50, an advance of 100 per cent. in the price in a little over four months, and 12 points advance in less than a week. Ten shares of the stock sold at 38 last Thursday. Central Union is one of the most inactive stocks on the list and but five trades in it have been reported since March 22d. They were as follows: March 22, 25 shares at 25; May 3, 20 at 30; June 29, 18 at 35; August 5, 10 at 38, and August 10, 28 at 50. It is reported that the company is in a position to pay a dividend and will soon declare it. Nothing has been distributed on the stock since the first quarter of 1896, when a one per cent. dividend was paid for that period. For five years previous to 1896 dividends were paid at the rate of five per cent. per annum regularly. The company operates telephone exchanges in the principal cities of Illinois, Indiana and Ohio, excepting Chicago, Cincinnati and Cleveland, and has encountered much opposition during the last few years.

There has been considerable comment upon the steady advancement in the price of Chicago Telephone stock from 165 to 200 in 30 days. The record of the company for the first six months of this year, in the face of depression in many lines of business as shown by comparisons with last year, is very satisfactory. The earnings of the lines within the limits of the city of Chicago show an increase for the six months ended June 30th of over four per cent., compared with the corresponding half of 1896. The company recently paid over to Comptroller Waller the sum of $21,137.27, being the three per cent. tax on gross receipts of the company's city lines provided for in the compensation clause of the ordinance which granted the company its rights. This offers an opportunity to compare the gross earnings of those lines for the period mentioned. The gross earnings of the city lines for the first six months in 1897 were $704,575, and in 1896, $677,817, showing an increase for 1897 of $26,758. Last year the gross earnings of the same lines for the same period showed an increase of $57,844 over 1895, so that this year's showing is equal to an increase of $84,602, or 13.6 per cent. over 1895.

Telephone Litigation.

[From the Boston correspondent of the Western Electrician.]

The answer of the American Bell Telephone company and its kindred corporations to the complaint brought by the Western Telephone Construction company of Chicago, alleging infringement of the Keelyn patent, has been filed in the office of the clerk of the United States Circuit Court in Boston. It is a general denial of the allegations in the complainant's bill. The Bell company claims to have been using instruments embodying the alleged invention for several years, and denies that there is any novelty in the Keelyn patent. It claims, too, that the essential features were embraced in improvements which were covered in the following patents:

No. 186,787, dated January 30, 1877, and granted to Alexander G. Bell for "Improvement in Electric Telephony."

No. 200,631, dated February 26, 1878, and granted to John Trowbridge for "Improvement in Telephones."

No. 204,027, dated May 21, 1878, and granted to Elisha Gray, for "Improvement in Speaking Telephones."

No. 204,029, dated May 21, 1878, and granted to Elisha Gray, for "Improvement in Speaking Telephones."

No. 214,029, dated April 8, 1879, and granted to Adolf Eccard, for "Improvement in Speaking Telephones."

No. 233,527, dated October 19, 1880, and granted to William C. Lockwood, for "Improvement in Telephones."

No. 237,379, dated February 8, 1881, and granted to Gay W. Foster, for "Improvement in Telephones."

No. 245,919, dated August 16, 1881, and granted to David W. De Forest, for "Improvement in Telephones."

No. 309,476, dated December 16, 1884, and granted to James Lowth, for "Improvement in Telephones."

No. 318,058, dated May 19, 1885, and granted to Henry E. Waite, for "Improvement in Magneto Telephones."

No. 516,642, dated March 20, 1894, and granted to Henry A. Chase, for "Improvement in Telephones."

In substance, the Bell company alleges that the Keelyn patent, 581,350, does not constitute any new and useful art and that it does not exhibit or embody any substantial variation or change from what had belonged to the state of the art as it existed at and before the time of Keelyn's assumed discovery, but had already become a matter of common knowledge among ordinary electricians and mechanics skilled in the art of constructing telephonic apparatus and instruments.

Telephone News from the Northwest.

[From the Mioneapolis correspoodent of the Western Electrician.]

For greater convenience in operating their lines in conjunction, the Rocky Mountain Bell, the Lewistown and Great Falls and the Northern Montana Telephone companies have agreed to occupy the same office at Great Falls.

Prescott, Wis., has established connection with Trimbelle, Ellsworth, River Falls, Hudson and Maiden Rock.

A. Foster has severed his connection with the Rochester, Minn., Telephone company, and has engaged with the Automatic Telephone Exchange of Amsterdam, N. Y.

The Mutual Telephone company of Des Moines, Ia., has begun operating its system, with connection in 26 towns.

The Elroy, Wis., Telephone company will extend to Wonewoc, Wis., at once.

The Dakota Central Telephone company has connected with Summit, S. D.

The Wausau Telephone company has connected with Tomahawk, Wis.

The Southwestern Telephone company is extending a line to Mt. Horeb, Wis., from Dodgeville.

The Forman Telephone company of Milnor, N. D., will extend its lines to Wahpeton, N. D.

The Northwestern Telephone Exchange company is having trouble getting a right of way for its long-distance line near Willmar, Minn.

It is understood that the Fairmont Telephone company will extend its wires to Heron lake, Minn.

The Sibley County Telephone Exchange company has been organized to construct telephone exchanges in Sibley county, Minn.

Swaledale, Ia., now has telephonic communication with the outside world over the wires of the Iowa Telephone company.

The Richmond County Telephone company has completed a line from Muscoda, Wis., to Homer, thus connecting Grand and Richland counties.

The Northwestern Telephone Exchange company of Little Falls, Minn., will make no more additional telephone connections until enough have been secured to make the number in use 50, when an exchange will be put in. There are now 36 instruments in use at Little Falls.

The council of Rapid City, S. D., has given the ordinance granting a right of way and privileges to the Harrison Telephone company the third reading.

Electric Torpedo Boat Launched.

The Plunger, a submarine torpedo boat of the Holland type, designed for the United States navy, was successfully launched at the yards of the Columbia Iron Works, Baltimore, on August 7th. The boat is cigar-shaped, 85 feet in length and 11 feet five inches in diameter. When floating light it had a dispacement of 155 tons, and, when down to the load line, 167 tons. A steam plant is provided to operate twin screws when afloat or awash, and a 70 horse power motor, furnished with current from 48 storage batteries, will operate the vessel when submerged. The steam power, electric dynamo and storage cells are so arranged as to be readily reversed, thus making it possible to recharge the cells from the power plant on the boat. The electric power may also be connected to the propelier shaft placed in the axis of the boat, in addition to the connection with the main propeller shaft. The motor may thus operate a special propeller in addition to driving the main shaft independently of the steam engines.

Know Their Passengers.

[From the Boston Evening Traoscript.]

The student of sociology will find a good many of the old New England ways still enough alive to travel on rural trolleys. On one line in Boston's suburbs the conductors and motormen know their passengers. The other day a conductor excused his hurry in making change by saying he had to "look after Mrs. Blank, 'cause she's lame." Having helped that lady to reach terra firma, the conductor resumed the collection of fares, beginning with a little girl, of whom he asked: "How's father's cold to-day, Annie?" Needless to say that the conductors are "Johns" and "Henrys" to many of the patrons. The line is well operated, for the old New England democracy always knew how to get there on schedule time.

Electricity to Supplant the Cable on Chicago South Side Lines.

The Chicago City Railway company has made official announcement of the contemplated transformation of the cable lines of its system into trolley lines. This action had been anticipated, but no official statement was issued until August 10th, when employes on the State street and Cottage Grove avenue lines received cards notifying them of the plans of the company. The cards also informed the employes of a contemplated reduction in their wages.

In financial circles the decision to convert the cable lines of the company is construed as meaning that an extra dividend of at least 20 per cent. will be made to City railway stockholders through an issue of new stock. It is roughly estimated that $2,000,000 will be required to change the equipment as proposed. If stock is issued to raise the amount, which is likely, it will, according to the company's custom, be issued to the present stockholders at par. City railway stock now sells at 245, but allowing for an easier price on the issuance of the new stock, suppose it has a certain value of 220. The issuance of $2,000,000 of stock at par would mean a gift to the stockholders at $2,400,000, or 20 per cent. on the capital stock of $12,000,000. The additional dividend requirement by reason of the issuance of the $2,000,000 new stock would be $240,000. This amount, it is claimed, would be more than made up by saving in operating expenses and increased traffic, the result of the introduction of the trolley, and the 12 per cent. dividend would in nowise be impaired.

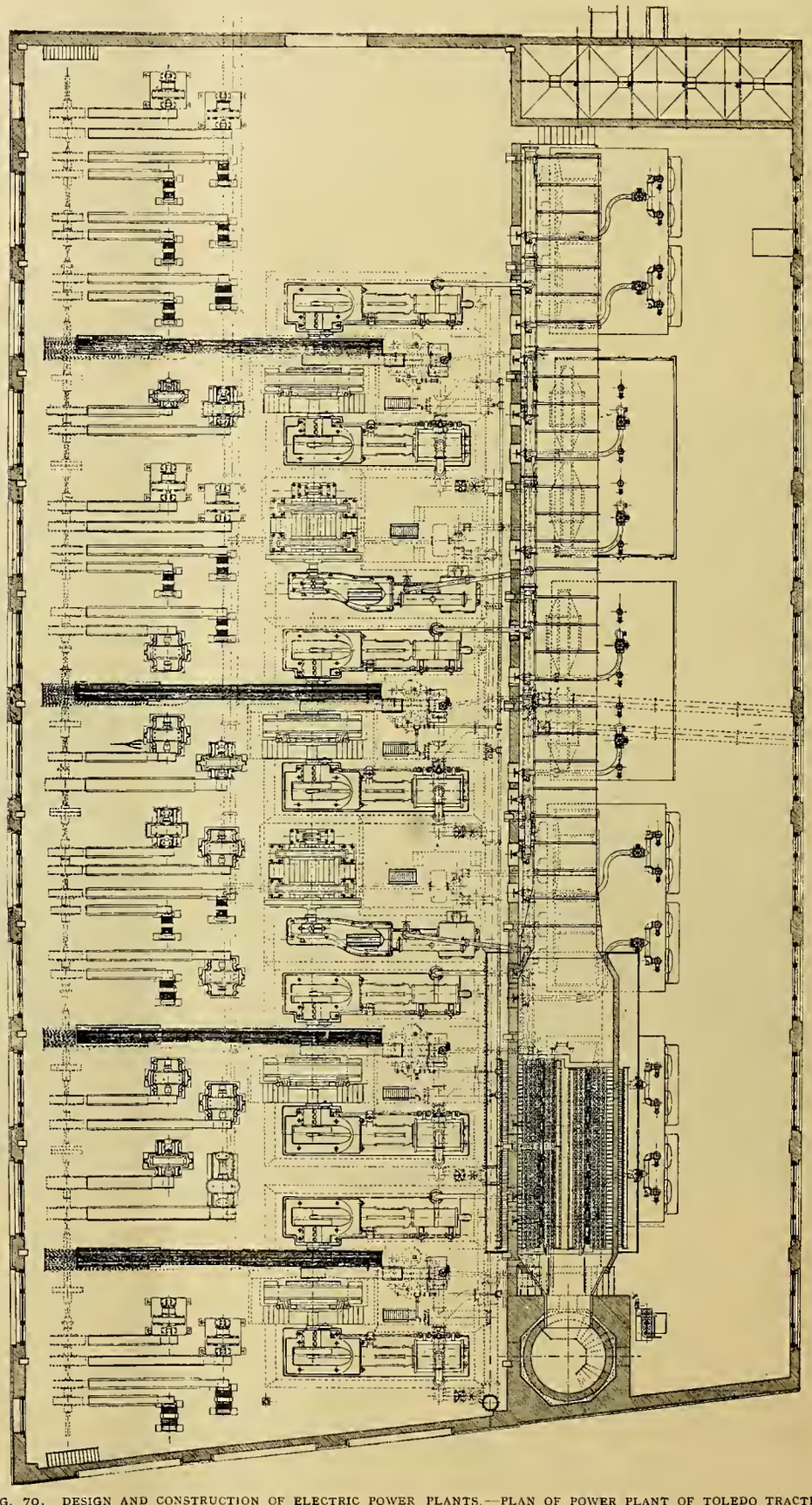


FIG. 70. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—PLAN OF POWER PLANT OF TOLEDO TRACTION COMPANY.

Interesting Results of a Test of a Government Plant.

The new electric lighting plant in the government hospital for the insane at Washington, D. C., comprises two engines and four dynamos connected by rope drive. The larger engine is rated at 200 horse power and the smaller one at 100 horse power, while two dynamos are equal to an output of 50 kilowatts each and two to 30 kilowatts each. The plant is housed in a separate brick building and is designed

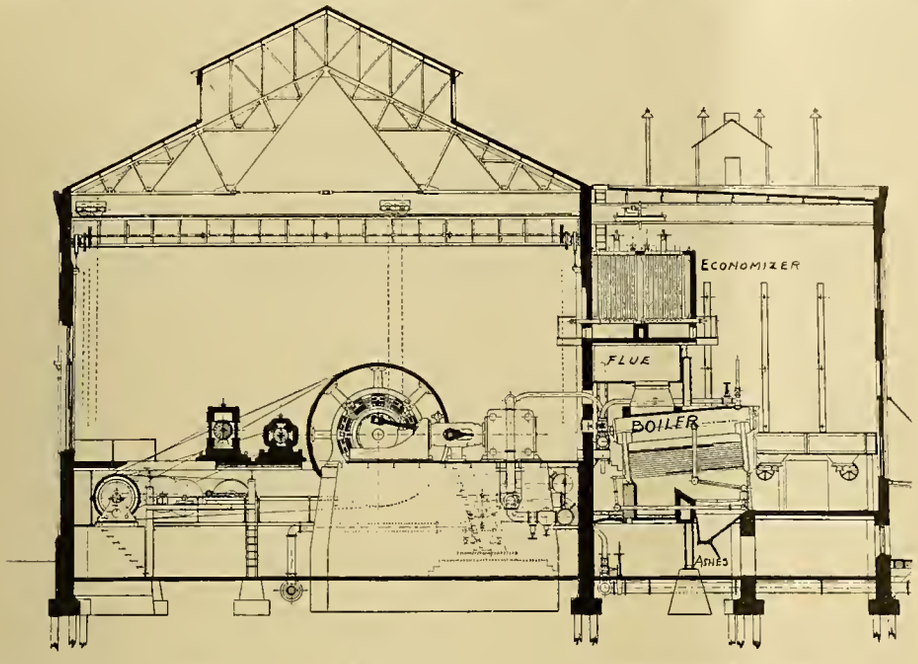


FIG 71.—DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS —TRANSVERSE SECTION OF THE PLANT OF THE TOLEDO TRACTION COMPANY.

to supply current to about 3,000 lamps. It was planned by G. W. Baird, chief engineer of the United States Navy, who, in the Journal of the American Society of Naval Engineers, makes the following general remarks about it:

The output of these plants, compared with an equivalent gas light, as obtained from the ordinary batwing burner, at Washington prices, is favorable. A five foot burner gives a light equal to 16 candle power. At one dollar per 1,000 feet of gas, we obtain 16×1,000÷5=3,200 candle power per hour for a dollar.

Taking coal at $2.65 per ton, lamps at 20 cents, repairs at two per cent., and allowing an expenditure of 3,000 lamps per year, and a full load on the small plant, the cost per year will be about as follows:

Three engineers	$3,000
Three firemen	2,160
One electrician	1,500
Two linemen	1,200
Two laborers	1,000
Repairs	1,000
Lamps	600
Coal	2,453
Oil	200
Total	$13,113

or $1.50 per hour. The output of the small plant, at the poles, was 57,200 watts per hour. The drop would reduce this about six per cent., so that the output at the distributing board would be about 53,768 watts. Taking lamps at 3.2 watts per candle power, the current would give 16,800 candle power for $1.50. Reduced to a dollar, it would be 11,200 candle power for the electric plant, and, as shown above, 3,200 candle power for the gas. The gas output may be doubled per unit of gas by using the Welsbach burner, but the cost of replacing the mantles is considerable, probably half the price of the gas saved.

The output of this electric plant is 228 watts per pound of coal per hour, which, I believe, is a more economical result than is attained anywhere in the District of Columbia. The electric plants in the capitol are giving excellent results, but they are using Bulkley condensers, the water for which is pumped up by other machinery, the expense for the latter not showing at the capitol.

One of the local electric lighting companies is charging 13.5 cents per 1,000 watts to private consumers; but to large consumers, particularly those who use most current in daytime, it makes a reduction, going as low as 10.7 cents per thousand. The plant at the hospital obtains it at 2.8 cents, neglecting interest on the money invested in the plant, and at 3.5 cents per 1,000, if six per cent. interest on the plant is allowed.

Wherever electric is substituted for gas lighting, a greater quantity of light will be used. For example, in the State, War and Navy Department building, the mean number of gas jets in use was 112, before installing the electric plant; since then the mean number of electric lamps used is about 372. Notwithstanding this great increase in the use of light in the building, the aggregate cost so far has not increased.

The consumption of lamps forms an important item in the expense of operating a plant. When I installed the plant in the Albatross in 1882, lamps cost $1 a piece; now they are bought at 17 cents. With $1 lamps, their lifetime was an important factor; it was economical to obtain great duration at the expense of current. Lamps which glow up to candle power at 3.1 watts per candle power will not last more than half so long as those which consumes four watts. If we assume 4.3 cents per 1,000 watts for current and allow 500 hours for each of two lamps (making 1,000 hours), the total cost of the lamps (at 17 cents), and the current for the 3.1 watt lamps will be $2.47; assuming the same cost for current used in a four-watt lamp, and taking a single lamp at 1,000 hours, the cost will be $2.92. These figures are from the results I am now obtaining from the plant in the State, War and Navy Department building. It will be seen that the difference in favor of the 3.1 watt lamp is 18 per cent. The total number of lamps in this installation is 2,025, and in the executive mansion (which is lighted by the same dynamos) 950, making 2,975 in all. The expenditure of lamps in this building for the year was $1,278, or about 63 per cent. of the installation, but during the first part of the year four-watt lamps were used. The present expenditure is at the rate of 1,800 lamps, or nearly 90 per cent. of the number installed. The central stations figure on two complete renewals a year; they purpose renewing lamps when they glow quite red. My method, in the above building, is to shift the lamps from time to time from the remote parts of the building to places nearer the dynamos, thus subjecting them to a higher voltage, as there is a drop of 2.5 volts between the switchboard and the farthest lamp. In this way we manage to get a greater life out of the lamps, and yet keep them nearly to candle power.

The mean load factor on one plant in the State, War and Navy Department building during the year was about 22 per cent. During office hours it rose to a mean of 36 per cent.; the maximum during first quarter was 53 per cent., second quarter 66 per cent., third quarter 114 per cent., and fourth quarter 73 per cent. A second plant is used to prevent an overload on the first. Our load on Sundays often falls to 12.5 per cent. In electric lighting, as in other commodities, the higher the load factor employed, the greater the economic efficiency.

Design and Construction of Electric Power Plants.

By Bion J. Arnold, M. S.

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Part XI.—*Continued.*

Plant of the Toledo Traction Company.—Fig. 70 illustrates another case where it was necessary to install a power station for furnishing current for light, power and street railway circuits, but the arrangement adopted for this plant is much more compact than that of the last example. Both direct-coupled and belt-driven generators are used. Two independent sets of direct-connected generators are installed with tandem compound engines. The other four direct-connected generators, however, are each mounted upon the shaft of a cross compound engine, which also carries a large driving pulley for a rope drive. This fly-wheel pulley is connected by means of a rope transmission, wound on the American system, to a countershafting located under the engine and dynamo floor and extending the entire length of the building. The traveling carriage and sheave for keeping the rope tight are also placed beneath the floor. The shaft is divided into four sections, provided with friction clutch couplings so that each engine can operate the section to which it is connected independently, or all four sections can be connected. The generators are placed on the floor above the shaft and are run by belts which are tightened by sliding the dynamos on their bases. Each belt passes over a friction clutch pulley upon the shaft, the clutches being operated from the dynamo room by means of hand wheels, the spindles of which pass up through the floor from the line shaft. This arrangement leaves a fairly open floor for the dynamo attendants, while the plan of putting the rope tightener beneath the floor instead of arranging it above the shaft allows the use of a crane. It will be seen then that the cross compound engines not only drive the countershafting, but at the same time they operate the generators directly attached to their shafts. This arrangement is made possible on account of the continuous demand for current by both classes of service represented by the two types of machines.

The engine cylinders are arranged as they always should be, so as to make the shortest possible steam pipe connection. A large steam header is supported on the fire wall dividing the engine and boiler rooms on the boiler room side. All the gate valves which cut off the supply of steam from the boiler to the header can be reached from the engine room floor. This is a wise provision, as in case of trouble to the header the engine room would not be filled with steam, while the attendant

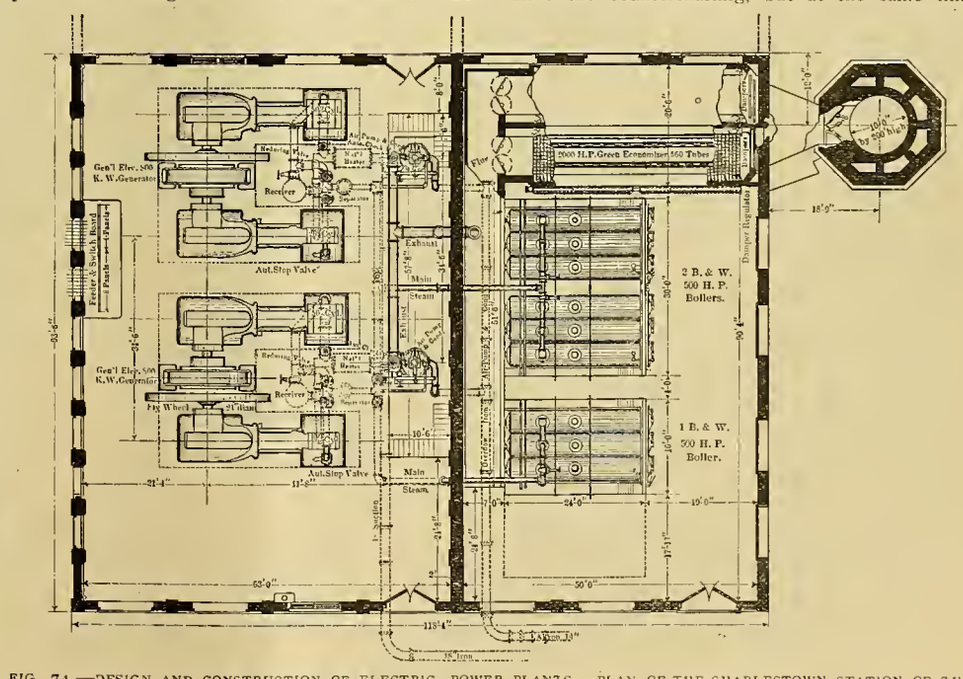

FIG. 74.—DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—PLAN OF THE CHARLESTOWN STATION OF THE WEST END STREET RAILWAY, BOSTON.

could reach the valve quickly, and cut out the faulty part without danger of being burned. All the leads from the boilers to the header and from the header to the engines are of bent pipe to allow for expansion, and both enter the top of the header. The header is divided into three parts connected by copper goose-neck expansion joints. The exhaust piping and condensers are placed as usual in the basement. Each engine has its own independent jet condenser, the air pump of which is driven by a belt from the shaft of the engine, and the boiler feed pumps attached to the cross-heads of the air pumps are also driven directly from the engine shaft. The boilers are arranged in five batteries of two each, with the flue for gases carried above. The stack is located at one end of the boiler room, and just before the smoke flue reaches the stack it is enlarged to make room for an economizer. This economizer is erected upon girder-rail construction, about 20 feet above the floor of the boiler room and has a by-pass flue below, which can be used when it is desired to cut the economizer out of service. It will be seen that this arrangement allows the use of one economizer for the entire plant, which is the plan that should always be adopted. The location of the economizer, in this case above the boilers, allows the floor space below to be utilized for the boilers themselves, but necessitates a somewhat high boiler room.

In this plant arrangements are made so that both the coal and the ashes are handled but once. The coal is delivered at one end of the building, shoveled onto a grating, through which it drops onto an elevator that carries it up an iron chute affixed to the wall on the outside and dumps it into the storage bin. In the bottom of the bin are four hoppers through which the coal is dropped into iron carts and hauled, after being weighed, to the boiler where it is to be burned.

For handling the ashes similar arrangements are made. A hopper under each furnace receives the ashes, which, from time to time are dumped into an iron wagon, hauled to the end of the room and dumped in front of the ash conveyor which delivers them to the wagons outside. The ash conveyor and coal conveyor are both driven by electric motors.

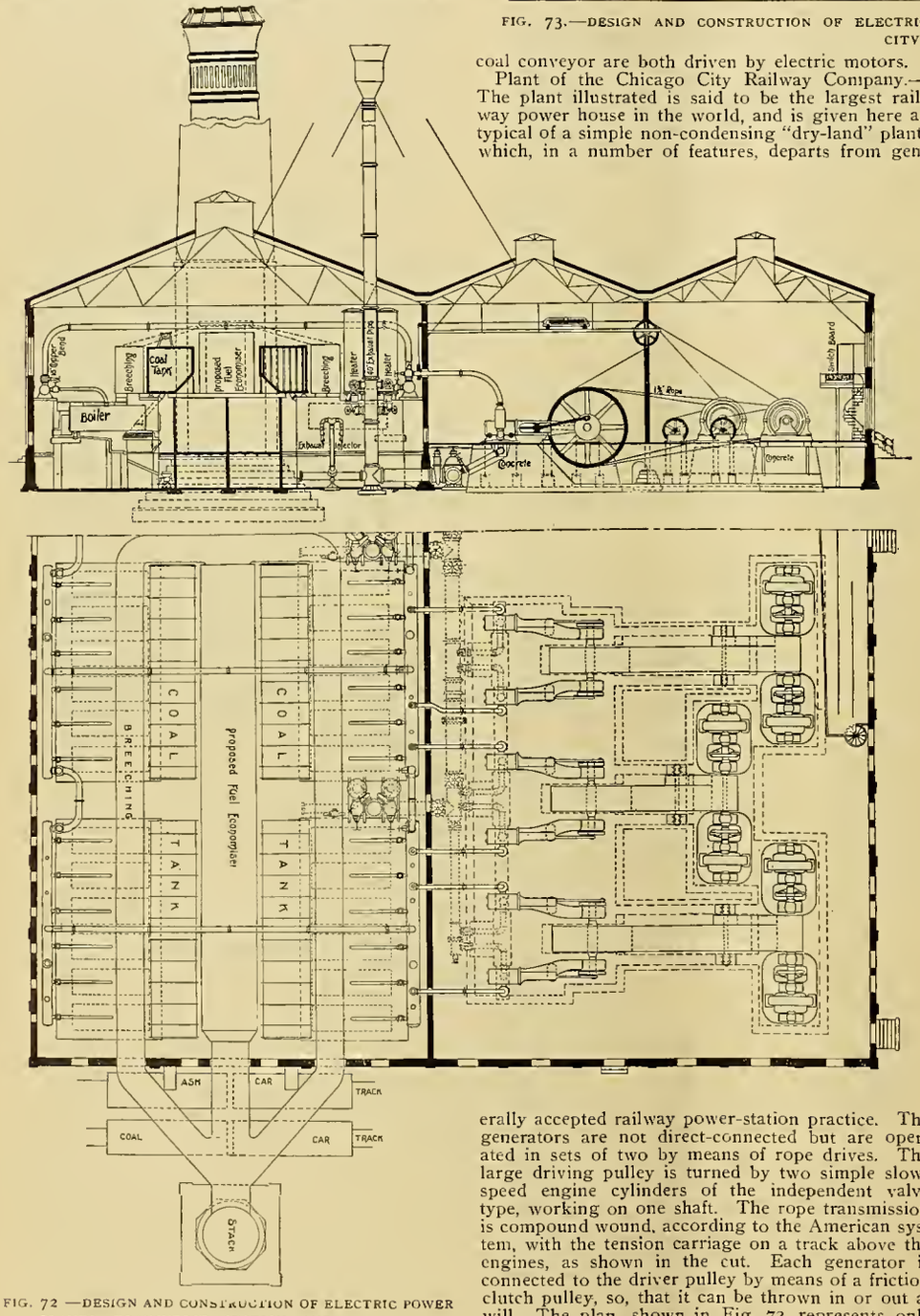

FIG. 72 —DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS—TRANSVERSE SECTION AND PLAN OF ONE HALF OF PLANT OF THE CHICAGO CITY RAILWAY.

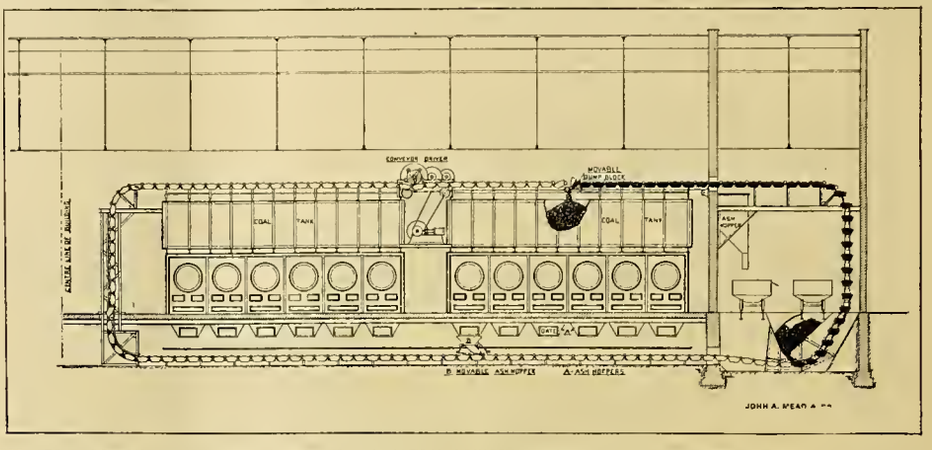

FIG. 73.—DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS—COAL AND ASH CONVEYOR, CHICAGO CITY RAILWAY.

Plant of the Chicago City Railway Company.—The plant illustrated is said to be the largest railway power house in the world, and is given here as typical of a simple non-condensing "dry-land" plant, which, in a number of features, departs from generally accepted railway power-station practice. The generators are not direct-connected but are operated in sets of two by means of rope drives. The large driving pulley is turned by two simple slow-speed engine cylinders of the independent valve type, working on one shaft. The rope transmission is compound wound, according to the American system, with the tension carriage on a track above the engines, as shown in the cut. Each generator is connected to the driver pulley by means of a friction clutch pulley, so, that it can be thrown in or out at will. The plan, shown in Fig. 72, represents only half of the plant, but will give an idea of the general floor space arrangement of boilers, engines and generators.

The boilers, which are of the horizontal tubular return flue type, are placed in banks of six in two rows, one on each side of the boiler room, with the common firing space between. Coal tanks for carrying a supply of fuel are supported by steel framework directly above the boilers, and coal chutes lead conveniently to the hoppers of the mechanical stokers. The breeching for the flue gases is carried above the boilers on both sides of the boiler room, the two passages uniting before entering the stack. Room for a fuel economizer is allowed in the center of the boiler room, dampers being placed in the breeching so as to lead the gases from the furnaces through the economizer pipes.

A steam header is provided for each battery of six boilers. The separate headers on each side of the boiler room are connected by copper goose-necks as usual, while the headers on opposite sides of the building are cross-connected. Each division of the steam piping is connected by valves, so that the station can not be shut down through the failure of any one part of the system. The engines deliver steam into a common exhaust header beneath the floor of the engine room, from which it passes through an upright heater directly to the atmosphere, except that portion used to feed water into the boiler by means of an exhaust injector.

The building is of modern steel construction, filled in with brickwork. It is built in three bays, for the boilers, engines and generators respectively. The switchboard is conveniently placed at one side of the generator room and is located on a gallery reached by a winding stairway at each end. The foundations for the engines and generators are solid masses of concrete, built up with manholes located so that access to the foundation bolt plates is an easy matter. The adoption in this case of the system of driving the generators by means of ropes, and the installation of fire-tube boilers, accounts for the size of the building.

The coal and ash handling apparatus is worthy of notice and is shown in Fig. 73. Two tracks run between the building and the stack, one of which is for the coal cars, the other being for the ash cars. The coal cars run over a hopper into which they discharge their loads. The coal then descends into the buckets of a conveyor which is driven by a small engine, and is deposited in coal tanks, shown above the boilers. Here an automatic tipping device is arranged so that the buckets will discharge the fuel at any point above either coal tank, as required. The empty buckets then descend on the other side of the boilers and return in a tunnel underneath. They are arranged so so as to receive the ashes from the boiler hoppers and discharge them into the elevated ash hopper, from which they are dumped into railroad cars on the ash track.

Charlestown Station, West End Railway Company, Boston.—Fig. 74, is a very fair example of a modern railway power plant of moderate capacity, and shows compact arrangement of machinery. Only direct-connected generating units are installed. The engines are of the cross-compound type and carry the fly-wheel on the same shaft with the armature. Between the engines and in the basement an upright receiver is placed. The steam piping to the engines is arranged so that either the high-pressure or the low-pressure cylinders can be used independently. The exhaust steam on the way to the condenser passes through a closed feed-water heater, and an auxiliary heater is also provided for the exhaust from the air and feed-water pumps.

The arrangement of the boilers allows for the installation of an additional boiler, but no provision has been made for another engine without increasing the size of the engine room. This plant is used as a sub-station and, therefore, it was not necessary to proportion the size of the units to handle the load economically, as is usually the case.

The economizer and by-pass are placed at one end of the boiler room. This arrangement takes up floor space but makes possible a low roof. The steam pipe leads from the boiler headers through the fire wall and down to a main header below the floor of the engine room, thus practically hiding the piping. The switchboard is conveniently located on a platform at one side of the building midway between the two generators. Plenty of windows in the building furnish abundant light.

Columbian Intramural Railroad Power Station.—This station, Fig. 75, is of interest as it contains a number of different types of railway generating sets. A is a tandem compound Corliss side-crank

engine with outboard bearing for the fly-wheel, and directly connected to its generator; B is a vertical cross compound automatic high-speed engine, also operating a direct-connected generator; C is a horizontal cross compound Corliss engine, with the fly-wheel and armature mounted on the same shaft; D is a high-speed, horizontal tandem compound engine with direct-connected generator, and E is a belted unit with a tandem compound slow-speed engine of the independent valve type, with the fly-wheel belted directly to the pulley of the dynamo.

The section, Fig. 76, shows the general arrangement of the machinery. The condensers, air pumps and boiler feed pumps were placed in the basement directly back of the engines. As oil was used for fuel and as no provision was made for handling coal, the usual position of the boilers could be reversed,

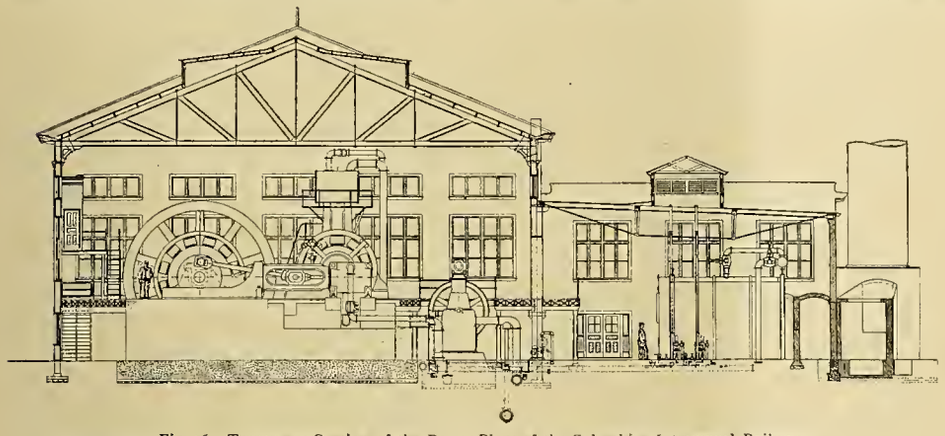

Fig. 76.—Transverse Section of the Power Plant of the Columbian Intramural Railway.

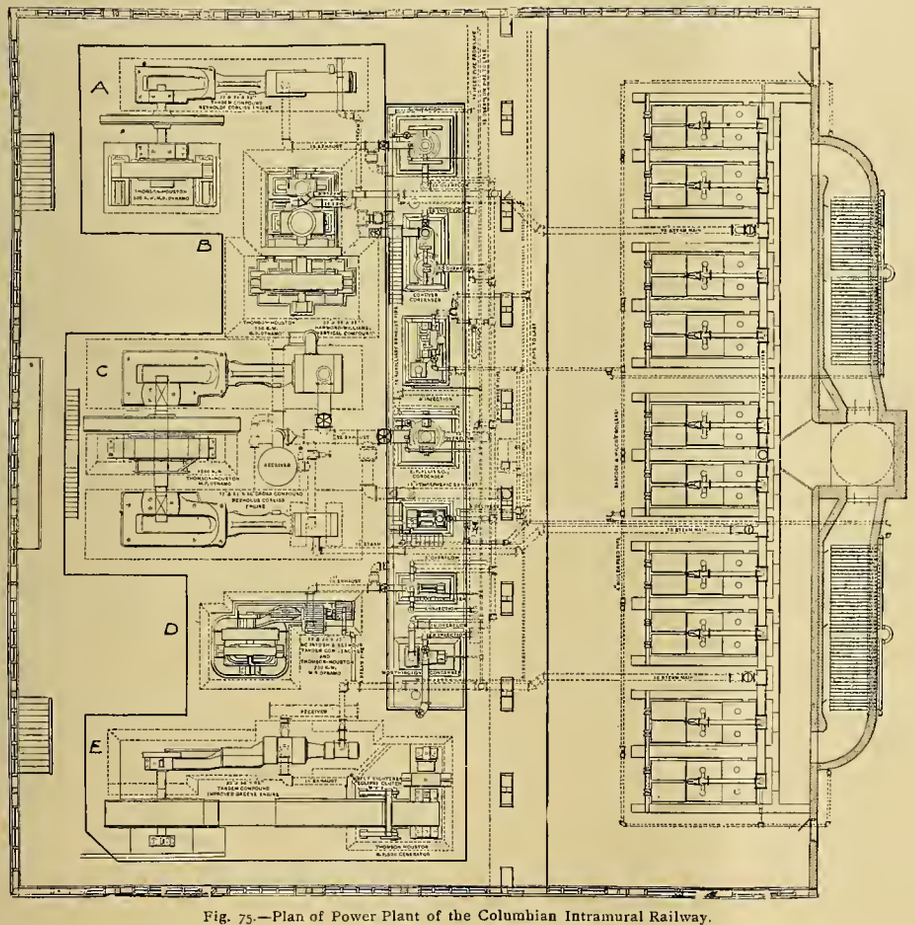

Fig. 75.—Plan of Power Plant of the Columbian Intramural Railway.

DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.

leaving the firing room next to the engine room and also allowing a neat arrangement of the flue for gases and the passages containing the economizer pipes. The stack was placed on the center line of the building and the arrangement of dampers allowed an easy control of the direction of the flue gases.

The steam from the boilers passed into a main header directly back of and above the boilers. From this header three main steam pipes passed down beneath the boilers to the engine room furnishing steam to the several engines. All the steam piping was supported independently of the building itself.

This building was located upon sand, which was submerged in water all the time, and the method of building the foundations is therefore of interest. An excavation was made 3½ feet deep and the length and width of the building, leaving a surface of sand submerged in water. Over this surface

[*Continued on page 93*]

Typical Motor Installations in Sacramento.

The utilization of electric power in Sacramento is becoming quite general since the introduction of the current generated at Folsom, 24 miles away, demonstrated its cheapness when compared with steam power. Electricity is now used in Sacramento to drive machinery of all kinds, and is entering largely into what may be called the household life of the city. One of the most important motor installations is that driving the machinery in the shops of the Southern Pacific Railway company. At about the time this was effected the Buffalo Brewing company of Sacramento substituted motors for the steam engines upon which it had previously been dependent for power. This brewery is one of the largest on the Pacific coast. Its present motor equipment consists of one five horse power, one 10 horse power, one 20 horse power and two 30 horse power motors. They are all of the General Electric company's three-phase induction type, without brushes, collector rings or moving contacts, and run almost without attention beyond an occasional oiling. They are driven by 200 volt current supplied from the 1,000 volt circuit running from the substation a distance of two miles, the pressure being transformed down at the brewery. The smallest motor is used in the bottle washing house; that of 10 horse power in the keg washing department, and the three others are used to operate the blowers, the malting house and the machine shops. The large ammonia pumps in the brewery will also shortly be driven by electric motors.

The printing presses of Day & Joy in Sacramento are also driven by motor. In this case the motor is of similar type to those in the brewery, but of 10 horse power capacity. It was one of the first in the city to take current of the long-distance transmission. On the day of its installation, the eight horse power engine, formerly used, was draped in crape. Its usefulness had departed, with its noise, heat and discomfort. The motor now drives one four-roller Huber cylinder press, one Cottrell press and two job presses, and although it has been in use a number of months has not involved the firm in a cent for repairs.

New Station of the Cincinnati Edison Company.

A large new down-town central station is about to be built for the Cincinnati Edison Electric company at Plum and Charles streets. The old station on West Eighth street, which is situated in a residence district, will be abandoned, much to the relief of the owners of adjacent property. The plans and specifications for the new plant are being prepared by Sargent & Lundy of Chicago. They will call for a complete, modern equipment of large size. The building will be fireproof and laid out in the manner usual for single-story stations. The stack will be of steel, 200 feet high and lined with fire brick to the top. There will be eight water-tube boilers of 500 horse power each in the plant at first installed, although here, as in every other part of the station, generous provision will be made for extension. Coal and ash-handling machinery will be installed, and the auxiliary steam plant will be most complete, including economizers, heaters and condensers, with the necessary pumps and other apparatus. Four engines—three of 1,500 horse power each and one of 750 horse power—will be put down. These will be of the vertical, cross-compound, condensing, medium-speed type, and will drive incandescent dynamos and arc machines. Both direct connection and belting will be used, the former for the incandescent and the latter for the arc machines. The arrangement will be such that any engine can be used to drive dynamos of either type or of both types.

Lightning's Queer Work.

[From the Chicago Chronicle.]

Hagerstown, Ind., August 2.—At noon yesterday, during a very severe electrical storm, the residence of Daniel Fist was struck by lightning. The lightning entered the house at a window sill in the second story, shattering into fragments a bedstead standing near by, and burned the covers on the bed. It then entered the wall half way to the ceiling, scattering the lath and plaster over the room.

The frames of several pictures that were hanging on the wall were torn to bits, the paper behind the glass was discolored, and the engravings totally ruined, while the glass was not broken in any of them.

A farm hand was in the adjoining room within a few feet of the wall that was demolished, and was not aware that anything unusual had occurred until he was apprized of it by others. This is the second time this house has been struck by lightning, although it has the latest improved lightning rods at every chimney.

Not the Jersey Variety.

[From the New York Sun].

The meteorological soothsayers who do the weather for this neighborhood had given up business for the night when the spectacular storm weavers of New Jersey, who are responsible for most of the electrical outbursts in these parts, began to put up a cloud building on the other side of the Hudson.

Not being able to get the figures of the soothsayers, the Sun is forced to rely on its own forecaster, whose spirit of prophecy is confined chiefly to telling about things that have passed into history. The thunder shower was not expected by the soothsayers. It came up in a somewhat unusual way. Instead of being preceded by a gust, it brought the gust with it. The cloud structure began to glow at short intervals with heat lightning, like a giant firefly. Then an unobtrusive midsummer drizzle came down.

That lasted until about a quarter of an hour before midnight. Then there was a change in the aspect of the western sky. The cloud structure began to tremble. There were jagged incandescent rents in its walls, and you could hear them tumbling. This is another way of saying that the lightning was vivid and that the thunder was of the roaring sort.

Lightning Ignited Gas.

[From the New York Herald.]

Bridgeport, Conn., July 30.—Coroner Doten today gave his finding in the inquest on the explosion on the steamer Nutmeg State, last Friday. The coroner attributes the accident to a current of electricity which ignited the naptha gas generated from the insect fluid used on the boat. He exonerates B. M. Reed, who used the preparation, from blame, and says the company's officers were not guilty of criminal carelessness.

The six injured victims at the hospital testified that they saw no stroke of lightning, but the manner in which the boat was damaged near the electric wires convinced the coroner that lightning caused the accident.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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With the Niagara Falls convention number of the Western Electrician, dated June 12, 1897, this journal made a new record for itself both in circulation and advertising. Of this 100-page number 20,000 copies[1] were printed and circulated and the amount of full paid advertising matter carried was 8,643 square inches.

1. State of Illinois, County of Cook—ss:
Thomas Jansen, being duly sworn, deposes and says that he is a resident of the city of Chicago, in the county of Cook and state of Illinois, and that he is the foreman of the printing department of the Electrician Publishing company, the publishers of the Western Electrician; that he was present at and superintended the printing of No. 24 of Vol. 20 of the Western Electrician, issued on June 12, 1897, and that there were printed by actual count 20,000 complete copies of said Western Electrician of the volume and number above specified. And further this affiant sayeth not.

THOMAS JANSEN.

Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

State of Illinois, County of Cook—ss:
Frank Foster Kenworthy being duly sworn deposes and says that he is a resident of the city of Chicago, in the county of Cook and state of Illinois, and that he is the superintendent of the binding department of the Electrician Publishing company, the publishers of the Western Electrician; that he was present at and superintended the binding of No. 24 of Vol. 20 of the Western Electrician, issued on June 12, 1897, and that there were sent out by actual count 20,000 complete copies of said Western Electrician of the volume and number above specified.
And further this affiant sayeth not.

FRANK FOSTER KENWORTHY.

Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

Beginning with the convention number of March 3, 1894, the record shows constant gains each year until in the present case the number of square inches of full paid advertising matter is more than double that of the 1894 number. The figures showing this unprecedented gain are given in the accompanying table:

Issue	Number of Advertising Pages.	Whole Number of Pages.	Square Inches of Paid Advertising Matter.
March 3, 1894	40	56	4,145
February 23, 1895	52	68	5,593
May 9, 1896	72	88	7,576
June 12, 1897	80	100	8,643

This constantly increasing patronage speaks eloquently of the influence and merit of this journal and of the confidence and respect which it commands throughout the country. It is pleasing recognition of the efforts that have been made in the interest of the entire fraternity.

Brooklyn has an electric fountain, and as a popular attraction it bids fair to rival the Yerkes' fountain that for years has delighted visitors to Lincoln Park, Chicago, and incidentally proved a source of great profit to the street railway lines in which Mr. Yerkes is interested. On the opening night in Brooklyn it is estimated that between 20,000 and 30,000 persons gathered at Prospect Park plaza to witness the wonderful display. It is a remarkable fact that the public never tires of exhibitions of this kind. In Chicago greater crowds visit Lincoln Park every year on nights when the fountain plays, and it is quite likely that this will also be the experience in Brooklyn.

With this week's installment of the Arnold lectures, that admirable series of articles on "Design and Construction of Electric Power Plants" is brought to a close. These contributions form a comprehensive work upon this important subject, embodying as they do all that is recognized as the best modern practice in this branch. The superiority of this work was early recognized by many of the engineering institutions of the country, and students in electricity and electrical engineering were encouraged to follow these lectures as a supplementary course. Many expressions of appreciation have been called forth by the publication of these lectures, showing conclusively that the need of such a work was generally recognized by the fraternity.

Those who are so eager for a governmental telegraph system should be willing to wait until the postoffice department has perfected the mail service, or at least brought it to a more satisfactory condition. Those who make no use of the telegraph are said to constitute 95 per cent. of the total population, and this leads a contemporary to ask: "Is this 95 per cent. to be taxed in order that the federal government may buy the plant and operate it, just to give lower rates to the five per cent. who patronize the telegraph?" It is estimated that it would require an outlay of at least $1.50 per capita for the government to buy the telegraph.

Improvement in the mail service, especially in the larger cities which bear the burden of expense, is much more desirable than the addition of a telegraph system under governmental ownership or control.

Good times coming? Of course they are. The improvement can be felt in all lines of commerce and industry now. "Trade is much better. Confidence has returned." These and similar expressions are found in newspapers that are opposed to the protective tariff policy of the present administration. The commercial agencies furnish favorable reports of the condition of general trade and the industrial outlook, while the returns of such corporations as the telephone exchange companies prove conclusively that the times are on the mend. The Chicago Telephone company, for instance, in its statement to the city comptroller, reports a marked increase in the business transacted during the first six months of the year, and this, too, in spite of the fact that the first six months of last year showed great improvement over the corresponding period of 1895. It is considered an excellent indication of improvement in general business when the telephone exchanges in the great commercial centers of the country make such favorable reports.

Wheelmen in Western New York will be interested in the plans of bicyclists of Rochester and Buffalo and of the intervening towns along the Ridge road to construct a model bicycle path between Rochester and Buffalo. An important feature of the scheme is the proposition to establish an electric lighting system which will enable wheelmen to enjoy this celebrated road at night without any of the dangers attending riding on lonely country roads after nightfall. The beauties of the Ridge road, which is certainly the most celebrated highway in Western New York, are appreciated at present by a number of riders who make trips on Sundays, and by comparatively few who ride that way during the week, but the novelty of a long ride on this path at night is known to few. When the road is properly lighted it is anticipated that it will prove very attractive to evening parties.

The telephone girl has found a champion in Trenton. That much abused servant of the public was the subject of a cartoon printed in the New York Herald recently entitled, "Hello, Central! Busy?" It pictured the operator sitting beside the switchboard, her chair pushed back, her feet resting upon a footstool and in her hand a cheap dime novel, which engrossed her entire attention. It must be admitted that the treatment of the subject was not particularly happy, and the chivalrous Jerseyman was moved to administer a well-deserved rebuke to the offending newspaper.

In criticising telephone service and the telephone exchange system it would be well for subscribers to bear in mind the fact that the lot of the operators is not exceedingly happy and that aside from the very exacting and trying service they are obliged to give they must submit quietly and peaceably to all kinds of treatment at the hands of subscribers, not daring to utter a remonstrance or protest, but are expected to remain courteous and obliging regardless of abuse. Consideration is certainly due these public servants who are obliged to sit during all the warm weather for ten hours a day facing the switchboard, a transmitter in front and a receiver fastened to the head of each of them. If users of telephones would comply with the instructions furnished by the companies the burden of the operators would be considerably lessened and the service vastly improved.

Because of the New Jersey statute of April 21, 1896, the Supreme Court of that state holds that electric light companies cannot lawfully erect poles in any street of a city, for public or private lighting, without first obtaining from the city a particular designation of the streets in which the poles are to be placed. Reliance was put in the case of the state against the Hudson County Electric company, in an early city ordinance purporting to authorize the company to erect poles "in all the public roads, public places, highways, streets, avenues and alleys of the city" for electric light, heat and power purposes. If circumstances should exist in which an electric company proposed to erect poles at once throughout every public street in a city for the purposes mentioned, the court says, such an ordinance as this might be considered a sufficient compliance with the statutory requirement. But when, as in the case under consideration, neither the city nor the company intended the immediate prosecution of so general a work, the court thinks an ordinance of this character a mere evasion of the law. To give it effect, it thinks, would be to authorize the company, instead of the city, to designate the streets in which poles were to be placed, whenever, in the judgment of the company, a proper occasion should arise. Furthermore, if a designation of streets by the city was, under this law, a necessary preliminary to the erection of electric light poles by the company, the court holds as illegal a resolution of the City Council providing for three electric lights on designated street corners, but leaving the whole plan of construction to the discretion of the city surveyor, especially as to the placing of poles for supplying electricity to these electric lights.

Profitable Extensions of Electricity Supply Stations.

By Arthur Wright.

Part III.

As the knowledge of the profit-earning capacity of any electricity supply station so obviously depends upon the correct method of determining the cost of supplying electricity, the author thinks that the accompanying tables, relating to the development of a supply station in the fairly representative English town of Brighton, will be found interesting.

He trusts that the results shown in the tables will be all the more useful to central station managers generally, as the profit-earning capacities of both the small pioneering and the large permanent stations erected in that town have been amply proved, and from which an uninterrupted supply of electricity to the public has been given; the economical working of the two stations has also been generally acknowledged, and lastly, the efforts there to get electricity generally used have succeeded in a remarkable way, as shown by the consumption per inhabitant at Brighton being far and away ahead of that in any other town in the United Kingdom; viz., 17 kilowatt-hours consumed per inhabitant this year. The columns of the tables have been arranged in a form which will enable company managers to compare their results with the figures given.

The first small station was built on the usual pioneering lines adopted by many companies before security of franchise could be sufficiently assured to tempt capitalists to put much money in the concern, and the second on the modern lines of a permanent station possessing an absolutely secure franchise. As both concerns, in their respective years, were quite free from any promoters' paper capital, and always gave a supply whenever and wherever called upon to do so, the author sees no reason why the figures given should not form a basis for estimating the cost of supplying electricity under the most diverse conditions, by the necessary alterations being made in the cost of capital, coal, etc., and thereby enable any manager to find out the proper basis upon which to construct an equitable tariff for any particular town or condition of supply.

Columns have been inserted in the tables giving equitable charges that should have been made to the consumers during the different years on the two systems of charging advocated by the author, the first being based on the principle of charging the amount shown in column 9 of table I., per annum per maximum kilowatt demanded by each individual consumer, and then charging all the electricity consumed, quite irrespective of the purpose for which it has been used, at the rates given in column 10 of the same table; and the other tariff, which is commonly known as the Brighton system, of charging a sufficiently high price per kilowatt-hour consumed, until all the costs the company is put to in standing by have been covered; these figures being given in columns 11, 12 and 13, respectively, of the same table. The fact of this system having been adopted in about thirty English towns will convince the members of its commercial practicability

On this tariff it is advisable to make the difference between the initial price and the reduced price as marked as possible.

In the preparation of the tables, the author has employed the method of cost analysis by differences, explained at length in his paper before the London convention of the Municipal Electrical association in 1896. In arriving at the total charges against the revenue accounts for the respective years, he has assumed that all stockholders would be quite willing to invest their money if 5½ per cent. on it were put aside out of revenue for the purposes of redemption and depreciation, and at the same time there was a reasonable chance of their getting another five per cent., at least, for the use of their money. He regards this as sufficiently liberal, as, so far as his knowledge goes, very few electricity companies set aside so large a percentage as 5½ per cent. on the whole of the capital for depreciation and repayment of capital, exclusive of dividends. With this provision the author has prepared the columns already referred to, showing what the tariff should have been to have produced this satisfactory result.

In a perfectly equitable system of charging, which, in the author's opinion, will generally be found synonymous with the soundest commercial tariff, it is obviously correct to make everyone, whether using electricity for power or lighting purposes, pay the cost the company is put to in preparing the plant to supply the individual consumer's demand. Column 9, table I., is therefore given, showing the cost of so doing during the various years, and it is obviously inadvisable to look for a profit on this expenditure, or on the service rentals, but to make the whole of the net profit for dividend-paying purposes on the amount of the electricity actually consumed.

It must be understood that these tables have been prepared without making any arbitrary assumptions, and that the various amounts for running, standing-by, and service rentals have been ascertained by the aforesaid method of differences and by a close analysis of the stations' cost sheets.

It will be seen from column 5, table III., that at Brighton, where coal on the average costs about $5 a ton, delivered in front of the boilers, the cost of producing the electricity has always been very small compared with the cost of getting everything ready to supply.

The author need hardly remind company managers that where coal is relatively cheaper, or water power is the source of energy, this proportionately large amount of standing-by costs will be still further increased.

It may be thought that all this great cost of putting the station in a position to run, compared with the cost of actually running the machinery, will practically disappear with a large extension of the motor supply business. This, in the author's opinion, is a complete fallacy, as the lighting load in

Table I.—Showing development of business, proper charges for service rentals, standing-by, and for current consumption.

Type of station.	System.	Date.	Year of operation.	Anoual sales of electricity. In. K. W. hours.	Anoual sales of electricity. In 50 watt lamp-hours.	No. of house services at end year.	Correct annual charge per service.	Correct annual charge for standing-by per consumers' maximum demand in K.W.	Correct charge per K. W. hour to pay cost of running and to produce additional 5 per cent. on investment.	Inclusive charge per K. W. hour consumed at the average rate in one hour per day throughout the year	Inclusive charge for supplying one 50 watt lamp one hour daily on average throughout the year.	Subsequent charge per lamp-hour (including renewals).	Ratio of charge for first lamp-hour to subsequent lamp-hours (exclusive of lamp renewals).
1	2	3	4	5	6	7	8	9	10	11	12	13	14
							$	$	cts.	cts.	cts.	cts.	times.
Pioneer....	Overhead wires, multiple series, H. T. continuous	1887	2	53,000	1,060,000	57	23.40	214	8.58	67.08	3.394	.469	7.8
Do.	H. T. alternating, house transformer system	1888	3	75,000	1,500,000	86	14 86	170	8.8	55.3	2.805	.48	6.3
Permanent.	Buried conductors, two-wire L. T. storage battery, 1,500 ampere-hours capacity	1892	1	156,041	3 120,820	212	14	82.1	9.775	32.27	1.664	.539	3.3
Do.	Ditto, three-wire L. T. sliding scale	1893	2	286,895	5.737 900	420	10.26	69.5	7.17	26.22	1.3505	.398	3.65
Do.	Ditto, with H. T. alternating sub-stations and L. T. distributors	1894	3	583,701	11,674,020	853	7.28	46	5.9	25.55	.9675	.335	4.34
Do.	Ditto	1895	4	867,494	17,349.880	1,065	8.60	49.8	5.28	18.93	.9865	.304	3.58
Do.	Ditto	1896	5	1,388,821	27,776,420	1,366	7.68	50.4	4.06	17.86	.933	.243	4.4

Table II.—Comparative effects of the correct charges during the various years of development.

Date.	Year of operation.	Inclusive daily charge per K. W. hour consumed in one hour.	Inclusive daily charge per K. W. hour consumed in four hours.	Ratio charges bear per K. W. hour if consumed in one hour and four hours respectively.	Ratio of charge for first lamp-hour to subsequent lamp-hours (including lamp renewals).	Inclusive charge for supplying one 50 watt lamp one hour daily on average throughout the year.	Inclusive total charge for supplying one lamp for four hours daily (including lamp renewals).	Inclusive total charge for supplying one lamp for ten hours daily (including lamp renewals).	Equivalent cost of gas giving same candle power with ordinary burners per 1.000 feet, according as the lamps are burned. 1 hour daily.	4 hours daily.	10 hours daily.	Annal cost of current for 500 watt arc lamp burning ten hours daily.	Inclusive annual cost of 500 watt arc lamp, with attendance and carbons, but exclusive of interest on lamp and post.	Correct charges for motors of 75 per cent. efficiency. Annual charge per maximum B. H. P.	Cost of current per K. W. hour.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
		cents.	cents.			cents.	cents.	cents.	$	$	$	$	$	$	cents.
1887.....	2	67.08	23.23	2.89	7.2	3.394	4.8	7.615	4.24	1.5	.95	264	307	214	8.6
1888.....	3	55.3	20.45	2.71	5.83	2.805	4.245	7.125	3.5	1.325	.89	245	286	170	9.
1892.....	1	32.27	15.4	2.10	3.1	1.664	3.28	6.515	2.08	1.025	.813	219	262	82	9.7
1893.....	2	26.22	11.93	2.2	3.38	1.3505	2.5425	4.9325	1.67	.792	.615	165	208	69	7.17
1894.....	3	25.55	9.66	2.82	2.87	.9675	1.9725	3.9825	1.21	.613	.498	131	174	46	6.
1895.....	4	18.93	8.7	2.18	3.25	.9865	1.8975	3.7225	1.235	.59	.465	121	164	50	5.28
1896.....	5	17.86	7.51	2.37	3.85	.933	1.6200	3.12	1.165	.505	.39	100	143	50	4.

Table III.—Data for determining the correct charges.

Date.	Year of operation.	Total annual standing-by charges per maximum K. W. at station.	Running costs per K. W. hour. Coal.	Stores and water.	Half repairs to machinery and plant.	Total.	Amount of profit to equal 5 per cent additional interest on capital invested.	Daily cost per 50 watt lamp of standing-by.	Correct charge per lamp hour for continuing to supply (including lamp renewals).
		1	2	3	4	5	6	7	8
		$	cents.	cents.	cents.	cents.	$	cents.	cents.
1887..	2	214.	3.	1.8	.48	5.3	1.735	2.925	.469
1888.....	3	189.	3.3	1.32	.68	5.3	2.615	2.325	.48
1892.....	1	103.	2.42	.09	.0368	2.546	11.265	1.125	.539
1893.....	2	94.25	1.416	.214	.0302	1.66	15.775	.9525	.398
1894.....	3	70.80	1.32	.324	.176	1.82	23.700	.6325	.335
1895.....	4	76.60	1.27	.162	.104	1.54	32.500	.6825	.304
1896...	5	73.70	1.016	.118	.077	1.21	39.125	.690	.243

Table IV.—Showing total investment and annual charges to revenue account.

Date.	Year of operation.	Capital sunk in undertaking at end of year.	Capital sunk in mains and services, exclusive of meters, etc.	Plant investment.	Total charges to revenue account, including service costs, and 5½% on capital.	Total annual service cost.	Total running costs for kilowatt hours sold.	Ratio of standing-by charges to actual running costs of year.	Cost per mile of street for mains and services.	Cost of mains per service connected.	Plant investment per service.	Plant investment per kilowatt of maximum demand on station.
		1	2	3	4	5	6	7	8	9	10	11
1887.....	2	$ 44,800	.....	.....	$12,720	$ 936	$ 2,810	3.19	.....	.....	.....	.....
1888.....	3	59,750	.....	.....	18,830	1,070	3,980	3.46	.....	.....	.....	.....
1892.....	1	255,000	$101,000	$ 72,300	22,450	2,060	3,975	4.16	$23,700	$480	$341	$452
1893.....	2	375,000	175,500	89,400	35,000	3,240	4,765	5.67	19,500	419	213	312
1894.....	3	574,000	266,000	132,500	51,200	4,630	10,650	3.38	15,200	312	155	262
1895.....	4	728,000	326,500	165,200	78,250	8,250	13,330	4.25	16,600	306	155	210
1896.....	5	857,500	384.000	194.000	99,000	9.350	16,800	4 34	17,500	281	142	196

Table V.—Showing lamps connected, maximum load, diversity factor and length of distributing mains.

Date.	Year of operation.	Equivalent No. of 16 candle power lamps connected at end of year as applied for.	Diversity factor of the consumers as a whole.	Mean of the two-years' station maximum loads in kilowatts.	Kilowatt hours sold in the year per mean maximum kilowatts.	Length of streets with distributing mains at end of year.
		1	2	3	4	5
						Miles.
1887.....	2	5,614	1	42	1,260	....
1888.....	3	8,880	1.11	73	1,025	....
1892.....	1	5,614	1.25	160	913	4.25
1893.....	2	9,880	1.36	287	1,000	9.5
1894.	3	19,243	1.54	508	1,150	17.5
1895	4	25,032	1.54	740	1,170	19.75
1896.....	5	33.319	1 46	990	1,405	22.05

any town will be very similar, however general the supply may become, and whether a constant day load is added to this or not makes no difference at all in the relative cost of supplying lamps one hour or, say, four hours. Until storage batteries become much cheaper than steam generating plants, the ratio of the standing cost to the running cost for lighting purposes will remain high.

As the standing charges of late years at Brighton have been found to rise nearly in proportion to the maximum annual load on the station, the author, in estimating the cost of supplying any customer, debits him with an amount of the standing charges in proportion to his maximum call for current.

The author calls the members' particular attention to column 4, table V., showing the enormous increase in the sales per maximum kilowatt load on the station that has occurred since the sliding scale of charging was adopted, at the beginning of the year 1893. From the column it will be noticed that this prolongation of the use of the plant has been no less than 54 per cent. in four years, and it is perhaps needless for the author to point out what a great effect this has had in reducing the cost of production, as, with coal costing even the high price it does at Brighton, an improvement of the load factor of only three per cent. has the same effect in reducing the total cost of producing electricity as if the coal bill had ben reduced 15 per cent.

It will be noticed from the tables that the only items that were found to vary with the amount of electricity actually sold from a given plant, were coal, stores, water and repairs. Should any managers find that their wages or other costs vary also on this account, it is easy to separate these into standing-by and running costs by the above simple method of differences. Perhaps it may be well to remind those members who did not read the author's paper on the "Cost of Electricity Supply," in England, last year, that this method of analysis by differences is a means for determining the cost the station is put to in having to supply every additional kilowatt-hour from its plant, and it consists in dividing the difference between the amounts debited in the six winter and six summer months, respectively, to the special account required to be so analyzed by the difference in the number of kilowatt-hours sold in these two respective periods, the result giving a very correct estimate of the running cost per kilowatt-hour during that year.

In the comparison of the cost of an electric lamp with that of gas, it has been assumed that the gas is of a quality known as 16 candles, which, burnt with ordinary burners, generally gives two candle power per cubic foot.

In order to make the comparison, in columns 8, 9, 10, of table II., between the charges for electricity and gas, applicable to other towns, it seems to the author fair to assume that the ratio of the cost of producing gas and electricity in any one town bears generally a constant ratio, as the items which affect this, such as the cost of capital, coal, labor, etc., would generally vary in similar proportions.

From table II. it will be seen that, even in the year 1893, when something under 300,000 kilowatt-hours were sold, the charges for a 16 candle power lamp, burning four hours a day throughout the year, would have been less than gas at 80 cents per 1,000 feet, and that last year, when the supply was under 1,500,000 kilowatt-hours, electricity burnt under these circumstances could compete with gas at 50 cents; while for street lamps or lamps used in basements all day long, electricity was cheaper than gas at $1 per 1,000 feet, in 1887, supplied from the small pioneering station.

Columns 11 and 12 of table II., giving the charges for current and total inclusive cost for a 500 watt arc lamp, may be of interest, as also may be the proper tariff for motive power, shown in columns 13 and 14 of the same table.

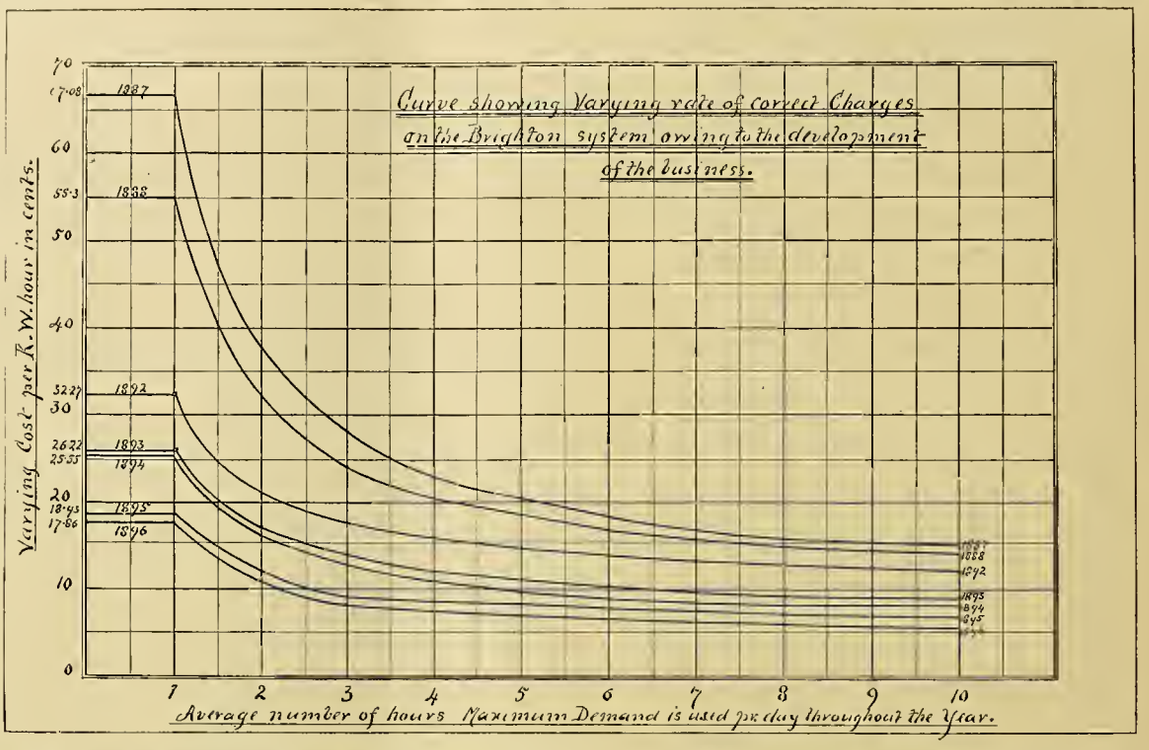
To illustrate how impossible it is for electricity to be supplied on a uniform tariff at so low a price to the lamps used in the average house of the middle classes as it can be profitably done on an equitable sliding scale, it is only necessary to note that to have produced the same amount of profit in 1896 the uniform charge per kilowatt-hour would have been, to this four hour class of consumers, 9.3 cents against the equivalent charge of 7.5 cents, or at an increased charge of 25 per cent.

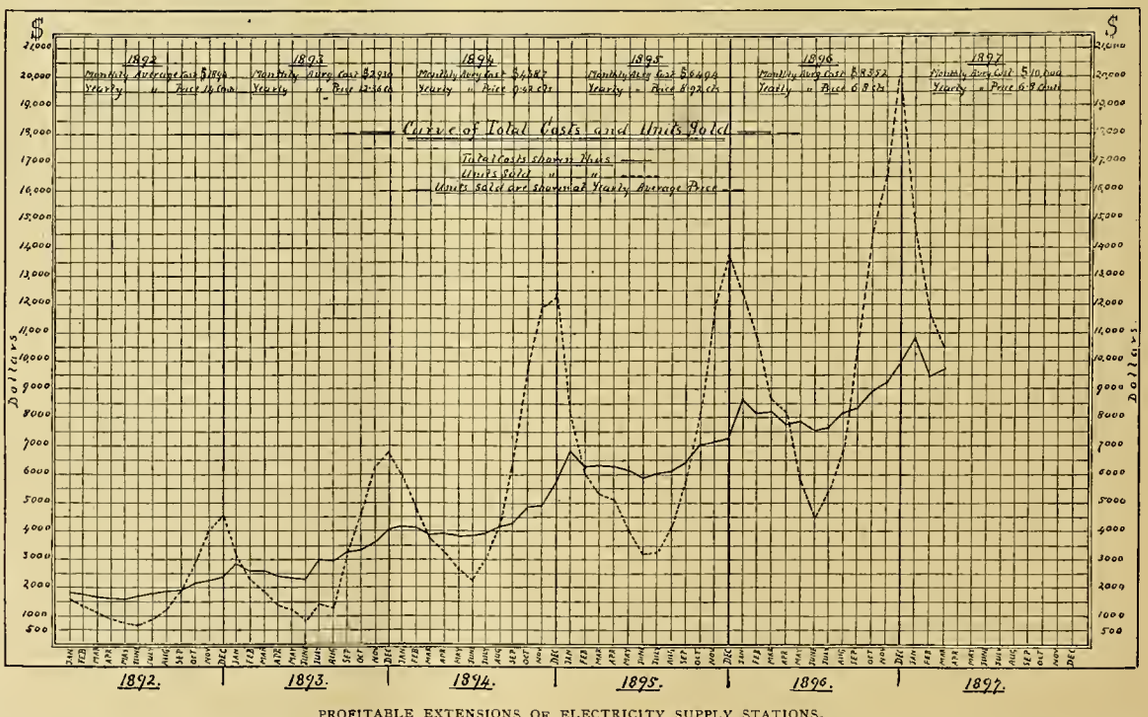
If we take the case of saloons and clubs, which keep open late throughout the year, and burn, on the average, their lamps six hours a day, the necessary uniform charge would have been 46 per cent. higher, and, in the case of basement users, using their lamps 10 hours a day, on the average, throughout the year, a uniform charge would have to have been 70 per cent. dearer than it could have been supplied on the system of equal profits, whereas the one hour consumer, on the uniform system, would have been charged 9.3 cents against the proper charge of 17.86 cents per kilowatt-hour, and, as 15 cents would have been the actual cost to the supply station in giving him this kilowatt-hour, the company would have lost no less than six cents for every kilowatt-hour so sold.

It may be thought that the amount of the service rentals shown in column 8, table I., to be equitable in the different years, may prevent the classes the author so strongly suggests should be catered for from being able to benefit in point of economy by a supply; but it is easy to show from the tables that even in the year 1894, with a sale of 583,701 kilowatt-hours in any ordinary residence where at least four lamps are generally used till 10 p. m., any householder should have been able to get electricity cheaper than gas. Moreover, directly cheaper forms of electricity meters are put on the market, and meter readings can be taken once a quarter instead of once a month, as hitherto, these service rentals will very much diminish.

In case any of the members should be inclined to think that there is no necessity to depart from the ordinary method of charging a uniform price per lamp-hour, the author has prepared the curves showing how very slightly the total costs of a central supply company vary in the different months of the year, notwithstanding the enormous variation in the number of kilowatt-hours sold. These curves, in the author's opinion, are the most speaking condemnation any manager can possibly have of the commercial unsoundness of the uniform method of charging.

In order to demonstrate very clearly the effect of the gradual development of the business on an equitable sliding scale of charges, the author has prepared the curves showing how the varying chare per kilowatt-hour, according to the number of hours the demand is used, has diminished in the various years, as many managers have suggested that this necessity for a high initial rate will disappear on electricity being more generally used.





PROFITABLE EXTENSIONS OF ELECTRICITY SUPPLY STATIONS.

Ground has been broken for the addition to the plant of the United States Electric Light company, at Fourteenth and B streets northwest, Washington, D. C. The new structure will be 134 feet square, of brick and stone, and will rest upon a very strong foundation of piles and concrete, capable of sustaining heavy machinery. The building will be one story high with a basement, and will cost about $75,000, the foundations alone costing over $24,000.

Design and Construction of Electric Power Plants.

[*Continued from page 89.*]

were placed two layers of three inch by 12 inch hemlock plank laid at right angles to each other and well spiked. This was covered with a concrete bed three feet thick, of the following composition: One part of American Portland cement to four parts of sand and four parts of broken limestone, thoroughly mixed and rammed into place. This brought the foundation about level with the surrounding ground. On top of this bed were built the foundations for the engines. These foundations were 10 feet high and were of brick laid in cement mortar, consisting of one part of American Portland cement to three parts of sand. The entire weight of the machinery was about 2,800 tons, resulting in a load of about 700 pounds per square foot on the sand under the foundations.

Plant of St. Charles Street Railroad, New Orleans.—The general arrangement of the machinery and of the building of this station, Fig. 77, is very similar to the one last mentioned, in that it follows what may almost be considered the standard plan, as it has been adopted by so many engineers. This arrangement places the engines in a room separated from the boiler room by a fire wall containing but one or two small doors closed with iron shutters. A space of about six or eight feet is allowed between the end of the cylinders and the wall, to allow a free passageway and also for the removal of the pistons when necessary. The floor of the engine room is raised above the boiler room floor, which is on the ground level, and the basement is utilized for piping and auxiliaries.

This station shows the details of the building construction somewhat better than the others. The foundation footings are of concrete in two layers, one 12 inches deep and the next 16 inches deep. The building wall is of brick, 13 inches thick, with pilasters 25 inches square to support the crane and roof trusses.

The crane is carried upon a T-rail track which rests upon I-beams supported upon the capstone of the pilasters. These I-beams are thoroughly anchored to the wall by means of one inch bolts passing through the wall and provided with a heavy washer to prevent their crushing into the brickwork.

The roof trusses are of steel and rest upon capstones. Across the trusses run purlins consisting of six inch I-beams, upon which are placed T-irons spaced about 18 inches apart. To these T-irons hollow tile is secured and the top of the tile is finally covered with asbestos roofing, making a completely fireproof roof. A monitor for furnishing light and for ventilating purposes is placed at the apex of the engine room roof, and a large ventilator is provided in the flat roof of the boiler room.

Plant of Ft. Dodge, Ia., Light and Power Company.—Fig. 78 shows an arrangement which can often be adopted with advantage where it is desired to economize floor space and at the same time save money in the first investment. In this case two generators were installed, thus providing a reserve in case of emergency. At the time the plant was built, however, but one engine was put in. This engine was of the slow-speed, side-crank Corliss type and was connected to the generators so that it could operate either or both of them. This was accomplished by the system already described in this course of lectures, and which is clearly shown by the accompanying drawing, Fig. 78. Shaft E is revolving only when engine No. 1 is operating dynamo No. 2. Provision was made in this plant for sliding the entire field frame of the generator along and parallel with the shaft, so as to allow easy access to the armature and field windings.

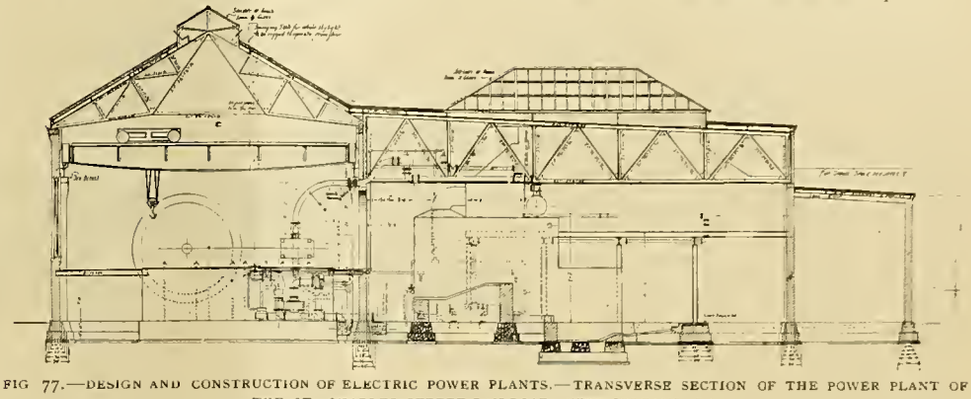


FIG 77.—DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—TRANSVERSE SECTION OF THE POWER PLANT OF THE ST. CHARLES STREET RAILROAD, NEW ORLEANS, LA.

The dotted lines show the method of increasing the capacity of the plant by installing a center-crank engine of double the rated output of the side crank engine, and another generator. When this is done the plant will have three generators and two engines, but the large engine will be capable of operating, if necessary, the three dynamos and the small engine can run two, so that almost as much flexibility is secured as though the engines and generators were connected to countershafting. The plant eventually will have the same capacity as one containing three direct-connected units, but with this arrangement the floor space occupied is much less, the foundations are smaller, the piping is simpler on account of there being one less engine, and for the same reason the amount of attention required for operation will be reduced.

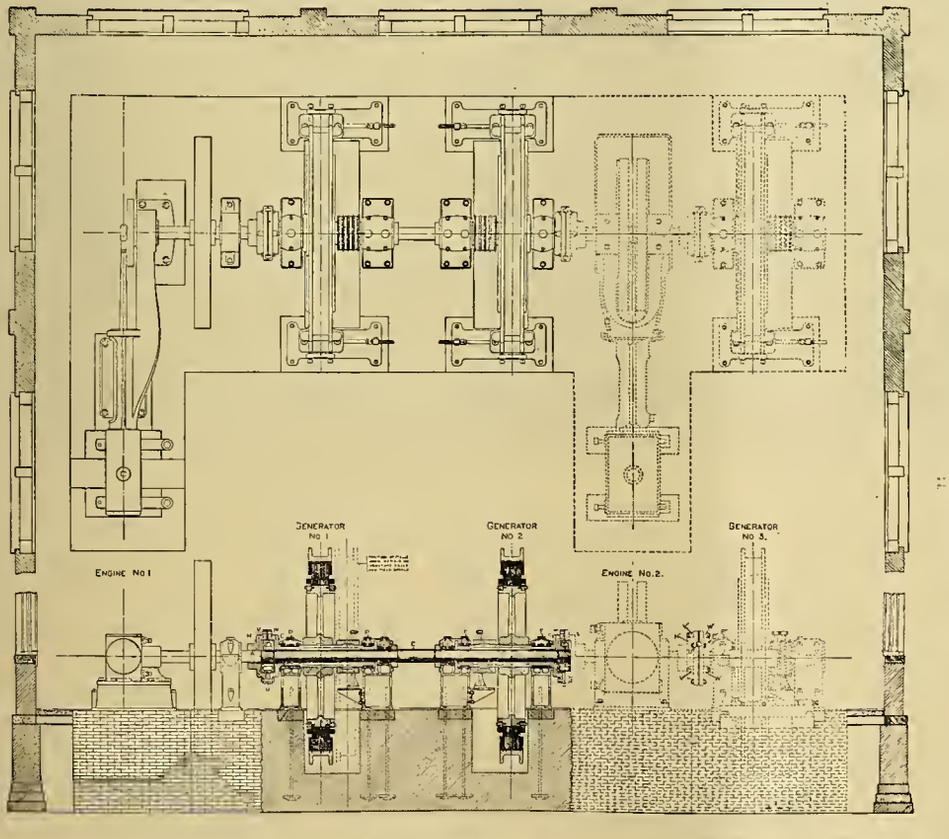


FIG. 78.—DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—PLAN AND CROSS SECTION OF ENGINES AND GENERATORS IN THE PLANT OF THE FT. DODGE, IOWA, LIGHT AND POWER COMPANY.

An unusual accident is reported from New Rochelle, N. Y. The New York Telephone company was stringing a line of wires across New Rochelle Creek between Main Landing and the Iselin property on Davenport's Neck, and a gang of linemen was setting poles. They were in mud up to their waists when one of the poles fell and almost buried several of them in the mire. Some of the men could not get up till help came. One, James McCormack of Yonkers, was badly injured about the legs and body.

Chicago Y. M. C. A. "Battery Party."

The "battery party" given by the Central Y. M. C. A. Electrical club of Chicago to its friends last Saturday over the Englewood and Chicago Electric road, was an enjoyable event. The large party which left the Young Men's Christian association building, at 153 La Salle street, was increased in size at Woodlawn, where special storage battery cars were in waiting for the club. The five-mile ride to the power house was thoroughly enjoyed by all, many of whom had never before experienced the pleasure of riding along at the rate of 18 miles an hour, on a smooth-running storage battery car. The entire absence of overhead construction, as well as underground conduit, was especially noticeable.

An hour was spent at the power house, during which time all the novel processes of removing the trays of batteries from the cars, of replacing them with charged sets, of lead burning, of the automatic transfer arrangements and of the charging of the cells, were thoroughly investigated. Everybody was profuse in praise of General Manager Condict's model power house.

The counterweight system at Morgan Park attracted considerable attention, as it carried the heavy cars up the steepest grade in the city. The feature of the afternoon, however, was the efforts made by the ladies of the party on the trip homeward to inform the natives along the route that the temperature in some ancient city was to be considerably elevated that evening. The accompanying illustration shows a picture of one of the cars in service on this occasion.

CHICAGO Y. M. C. A. "BATTERY PARTY."

Meters of To-day.[1]

By R. F. Schuchardt.

The importance of the meter question has long been recognized by central station men. The advisability of the sale of electricity by meter is no longer disputed. A good meter is always superior to the best contract for the station manager. The meter will give a good basis from which to estimate the schedule price instead of making him guess at it; the ratio of income to cost of operation will be fixed; there is less unnecessary burning, so the life of the lamps is considerably increased. The customer can regulate his light bill, and there will be square dealing on both sides. But to attain these advantages the meter must be at least fairly accurate. It is the intention of the writer to describe the condition of the commercial meters now in use.

Since 1872, when the first meter was patented in his country, much mechanical ingenuity and skill have been expended in designing and perfecting this apparatus, and well-known electrical engineers are still struggling with the subject, aiming at the production of a cheap and at the same time accurate and serviceable instrument.

There are three classes of meters—the electrolytic, clock and motor meters. In the first, the quantity of current is measured by the amount of metal deposited or the quantity of electrolyte decomposed in an electrolytic cell. The only one of this class which has found much use in America is the Edi-

1. Read before the Northwestern Electrical association at La Crosse, Wis., June 22, 1897.

son chemical meter, which, though exceedingly accurate under proper conditions, has the disadvantage of having no recording device, and like all electrolytic meters is likely to freeze unless heat is provided, which entails a loss.

Most of the clock meters consist of two clocks, one of which keeps accurate time, the other being retarded or accelerated by the action of the current on its pendulum. This retardation or acceleration is registered by a differential gear connecting the two clockworks, which, in turn operates a train of gears connected to the dial. The objection to most of these is that the clock must be wound up every month or so, which, if neglected, will cause the meter to run backwards and destroy all former readings. Of this class the Aron is the most successful, being constructed for both direct and alternating currents. It is, however, little used in America to-day.

The most important class comprises those meters which operate on the principle of the electric motor. The American meters of this class are the Thomson of the General Electric company, the Duncan of the Fort Wayne corporation, the Shallenberger of the Westinghouse company, and the Scheeffer of the Diamond Electric company. The Thomson is built to operate on both direct and alternating currents, and consists of a simple motor with no iron in the armature or field. All of the others are induction motors.

The ideal meter should be a wattmeter, as amperes do not represent the true consumption of energy, especially on an inductive load.

It should be direct reading and have a constant of unity.

It should start immediately with the smallest load, and be equally correct on all loads.

The meter should absorb no energy, nor should there be any drop of pressure through it.

It should be simple, both in construction and operation, and mechanically correct, so it can be easily installed and looked after, and it should not deteriorate in service.

It should be designed to operate with a slow speed.

The case should have a glass or mica window, so that the meter can be readily calibrated while in service, and it should be easily sealed.

Above all, it should be cheap without sacrificing any of the conditions mentioned.

George H. Jones of Fond du Lac and myself have just completed a thesis on American electricity meters, under Prof. D. C. Jackson at the University of Wisconsin, and I have drawn largely from our results for this paper. The investigations show that the meters of the present day are not all that might be desired, and you central station men, who know that the bills of customers, using approximately equal amounts of light, often vary to a great extent, and who continually have complaints of overcharges made to your companies, will bear me out in this. It is of the utmost importance that central station men test each meter they install. Many managers are beginning to realize the importance of this subject, and have added meter testing departments to their stations, where all meters are tested before they are installed. After they are once installed they should be inspected every six months or so in order to see that they are working properly. This is hardly ever done. Our method of calculating the error of the meter may be of interest: The speed of the meter is directly proportional to the load; therefore, for a given load the product of seconds per revolution of the armature and amperes (in ampere-hour meters), or watts, (for watt-hour meters), equals a constant (which we call K), which varies with the make and size of the meter. This K is the time in seconds which it takes for the armature to make one complete revolution per unit of load, ampere or watt.

The product of the observed load and seconds per revolution divided by this K, amperes×seconds ÷K or watts×seconds÷K, should then equal unity for an accurate meter and the variation from unity will give directly the error. Should this quotient be more than unity, the meter runs too slowly on that load; and if less than unity, the error will be negative, which means that the meter is running too fast. Thus, let the time per revolution be four seconds for load of 440 watts on a 10 ampere, 100 volt Thomson wattmeter; the value of K for this meter is 1800; then, 4×440÷1800=.978, which shows that the meter runs 2.2 per cent. too fast on that load; or, let the time per revolution of the armature be two seconds for 3.3 amperes on a 20 ampere Shallenberger ampere-hour meter in which the value of K is 6.33; then 2×3.3÷6.33=1.042. The meter is therefore 4.2 per cent. slow on that load.

ELECTRICITY ON SHIPBOARD—AFT DECK BREMEN, SHOWING EIGHT CRANES.

We found our samples of the Duncan watt-hour meters to run too fast, but by properly adjusting the magnets, their error could be brought within the limits of about five per cent. either side. Both of the Duncan ampere-hour meters tested started much too slowly and were also much too slow on the high loads. The effect of frequency is very marked, the difference in error at full load between frequencies of 60 and 130 being about 30 per cent.

After starting load, the Scheeffer wattmeter ran with a small and fairly uniform error. These meters are designed for frequencies, and when built for two frequencies are provided with a special German silver resistance in the pressure circuit to compensate for the difference. One of the meters tested by us, built for frequencies of 60 and 130, ran with an average difference of about six per cent. between these frequencies.

All of the new Thomson wattmeters started on no load, while the old ones started much too slowly. Their curve of error is a remarkably straight line after starting load. They are, of course, independent of frequency.

The Shallenberger ampere-hour meters started much to slowly. One of the three tested ran fairly uniform after starting, while the other two were too slow on high loads. The higher frequency makes them run from five to 15 per cent. faster.

The Shallenberger watt-hour meter was found to be very fair. It started on a very light load, ran without any great error, and responded promptly to changes of load. Frequency has no appreciable effect.

All of the meters tested are practically unaffected by the changes of pressure likely to occur in service. The Diamond wattmeter should not be used with inductive load, as the effect of such load is very marked, making the meter run much too slowly, and with a power factor low enough it stops entirely and even runs backwards.

Besides these meters tested in the laboratory, we were enabled, through the courtesy of the Madison Gas and Electric company, to test meters in actual service. The general results of this test indicate that the ampere-hour meters require a comparatively large current to start them and run much too slowly on starting load and on the higher loads. Most all of them have considerable error on overloads. The wattmeters are somewhat better, and, as a rule, run too fast on all loads except at starting, and with a fairly uniform error. The Thomson meters show the least variation in error, but the continuous watts absorbed are more than in any of the others.

A fact of great importance brought out in this test, is the lack of proper attention paid to the installation of the meter. In many cases the meters are placed on door frames, where they are continually jarred. They should be installed by securely fastening them to a firm wall, in a readily accessible, dry place, and well leveled. The meters should be carefully sealed to prevent being tampered with. The seal should bear the private mark of the company, so that any unauthorized inspection of the meter can be detected. The meter is a delicate piece of apparatus and should be carefully handled when being placed in position, so as not to injure it.

After it is installed, it should be tested to be sure it is running correctly. Spiders and insects in general are very fond of the warm meters and have many times helped to reduce the consumer's bill. The meter should, therefore, be dust-proof and should be regularly inspected.

In choosing a meter the following points should be considered:

(1) Accuracy.
(2) Registration.
(3) Power absorbed.
(4) Direct reading.
(5) Attention.
(6) Mechanical construction and durability.
(7) Cost, initial and continuous.

(1 and 2). The meter should be accurate within at least five per cent., either way, on all loads for which it is designed and should begin to register on at most one per cent. of its full load.

(3). The power absorbed should not exceed two wattts per 10 amperes capacity of wattmeter, nor should the full load drop through the meter be larger than .5 volt.

(4). The reading should be direct and not have to be multiplied by a constant. The multiplier means extra work for the clerk, and offers a chance for an error both in the calculation and in the possible omission.

(5). There should be no electrical contact makers, which rapidly deteriorate, and the meter should require no attention.

(6). Delicate mechanism should be avoided. The meter should not be liable to wear out nor get out of order readily. The cover should be dust-proof and capable of being easily sealed.

(7). Last, but not least, comes the cost of meters. This is not only the amount paid for the meter, but includes the cost of energy continuously absorbed. Take a meter costing $10 and absorbing 10 watts continuously, with interest at six per cent., energy at four cents per kilowatt hour, and 10 per cent. for depreciation, which probably is a low value for a cheap meter, the annual cost of the meter to the central station is $5.10. A meter absorbing two watts at the rate mentioned, would cost $3.90 per year. At the end of 10 years the first meter will have cost $61, while the $20 meter will have cost but $59, and it ought still to be in good condition at that time. The higher priced meter is likely to be the more accurate of the two. With a meter for every customer, this question of cost is a very important one to the central station manager.

There are several ways in which a meter can be tested. In some methods the load is computed from the time per revolution of the armature, and the true load found on an indicating instrument. We think that a "per cent. error" states the condition more clearly than any method which finds the error in amperes or watts for the different loads. We also think the stop-watch method the most satisfactory. It takes much less time and therefore less power than the five-hour full load test used in some methods. For a satisfactory test, the starting load should be found and also the time per revolution taken with a stop-watch, the accuracy of which can be relied upon, at starting, ¼, ½, ¾, full load and ¼ overload. Any number of ammeters can be connected in series and tested at the same time. With the aid of a slide rule, the per cent. error can be figured while the meter is coming up to speed on the next load.

Electricity on Shipboard.

The electrical equipment of the North German Lloyd steamship Bremen is said to be the most complete of any vessel of the merchant marine in the world. An interesting feature of the plant is the equipment of electric cranes, 16 in number, to supersede the noisy donkey engines. Four of these cranes have a capacity of 3,000 kilograms, or 6,614 pounds, and 12 of 1,500 kilograms, or 3,307 pounds, and have a total swing outboard of 20½ feet.

The generating plant is located in the after por-

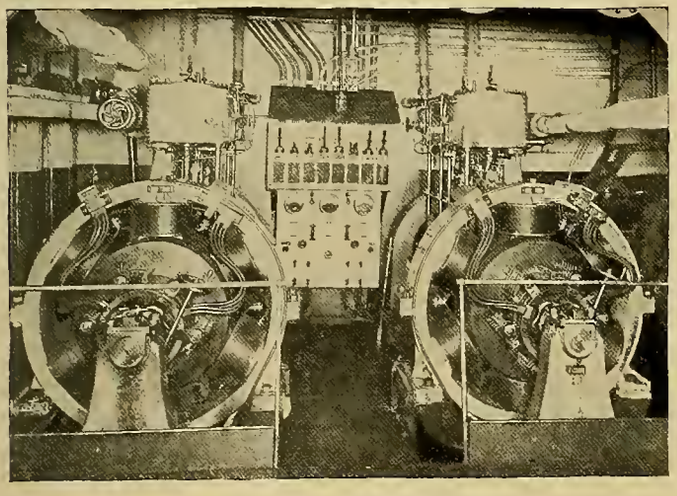
tion of the engine room and consists of four directly-connected dynamos, two on the starboard and two on the port side. The dynamos have each a capacity of 75 kilowatts or 100 horse power, and run at a speed of 210 revolutions per minute, delivering current at a pressure of 105 volts. The output of two machines is used for the cranes; one is used for the lighting of the ship, and the fourth is held in reserve. The engines are of the triple expansion type.

The cranes, motor and controlling mechanism are mounted upon a circular iron platform, which revolves upon a pivot. This is turned by a motor of seven horse power, running at 700 revolutions per minute, directly coupled to a worm gear, which in turn meshes in a gearing bolted to the deck. The loads are raised by a 25 horse power series motor, running at a speed of 900 revolutions, and driving a special worm gear meshing into the gear of the drum. On the gear end of the drum shaft is fitted a winch head.

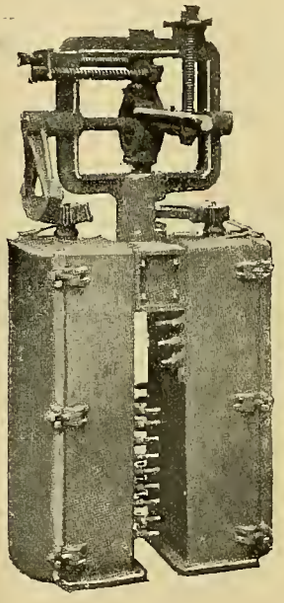
The controllers resemble a double street car controller about two feet high. They are fitted with magnetic blow-out, any spark being immediately extinguished in a magnetic field. The contact cylinders are operated by a special mechanism, actuated by a simple handle or lever, the movements of which correspond to the movements of the load. Raising the handle raises the load, depressing the handle lowers the load, and movement of the crane to the right or left is obtained by corresponding movements at the lever. Raising and swinging movements can be effected simultaneously. Motors and controllers are water-tight and dust-tight, but the cases of both can readily be opened when necessary. To give a more perfect control both motors are provided with band brakes operated by the foot. These brakes are attached to an extension of the motor shaft.

The difference between the large and small cranes lies in the hoisting speed. Practically both cranes are identical in electrical equipment, but the hoisting speed of the 3,000 kilogram crane at full load, 60 feet per minute, is only half that of the 1,500 kilogram crane at full load, which is 120 feet per minute. The movement of the jib of the cranes is 15 feet per second.

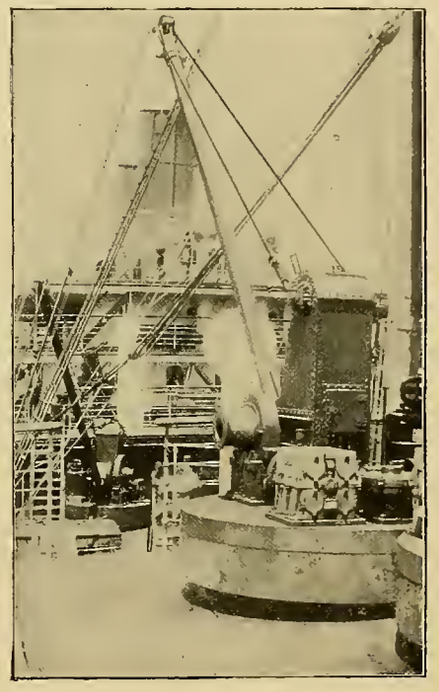
The most remarkable feature of the cranes, however, is the absolute noiselessness of their operation, which will recommend the electrical crane to shipbuilders, especially those of passenger steamers in such trades as that of the Mediterranean, where loading and discharging at every port is an important feature.



Starboard Dynamos, 75 Kilowatts Each, Steamship "Bremen."



Controller with Universal Gear.

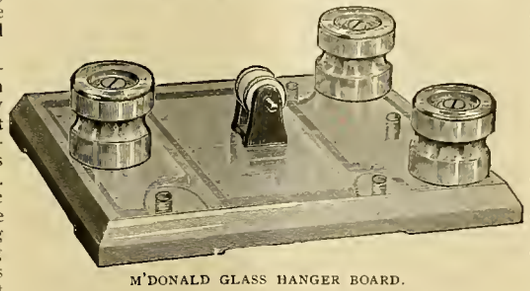


Cranes Showing Operating Handle.

ELECTRICITY ON SHIPBOARD.

McDonald Glass Hanger Board.

The insulation of appliances used in high tension series arc lighting is always of the greatest importance and particularly for inside arc light wiring, where a dangerous voltage is carried into the building and directly to the lamp. The McDonald glass hanger board, shown in the accompanying illustration, consists of glass insulating knobs mounted on a glass base or support. This secures a perfect insulation which will always remain the same, as moisture or corrosion is not possible. This hanger makes a bright, clean appearance, and can always be kept in that condition. The extra holes shown in the base allow the board to be used with three insulators, or with only two insulators, one at each end of the board. When a series of lamps is being hung the board at end of the series may be used with two insulators, while all the other boards should be used with three insulators. Thus, when the wire reaches the first board it is tied to the first of the two insulators at the double end; from this point a loop is made for the lamp and the line wire leaves from the other insulator on the double end. This is repeated on each board of the series until the last board having only two insulators is reached. On this board the line goes first to the insulator at one end of the board, then through the lamp to the insulator at the other end. From this point it starts back out of the building, using as support the free insulators on all of the boards having three insulating knobs. This makes a neat arrangement of the loops, and at the same time a perfect insulation of both wires. The McDonald glass hanger board is being placed on the market by the Electric Appliance company of Chicago.



M'DONALD GLASS HANGER BOARD.

CORRESPONDENCE.

New York Notes.

New York, August 10.—Now or never. Unless rapid transit plans are adopted at once it is feared that the long cherished project for an underground system will have to be abandoned. Even the commissioners seem to realize the necessity of immediate action and they have shown signs of life of late. This is because it is feared that if something tangible is not accomplished before Greater New York comes into existence there may be violent opposition on the part of Brooklyn, Richmond and Queens to the spending of so large a sum for the benefit of Manhattan and the Bronx, and that it will at least seriously delay carrying out the plans of the commission. It will now be necessary to proceed at once with the hearing of testimony by the commissioners appointed by the Supreme Court to pass on the question of the necessity of the proposed roads, and a favorable report from these commissioners, if approved by the court, will stand in lieu of the consents of the owners of property along the proposed route. So confident are the rapid transit commissioners of a decision in their favor that the form of contract for the construction of the underground railroads has already been drafted and put in type for their consideration. This document represents a good deal of work on the part of the commission's counsel and engineer. It makes a good-sized volume. The commissioners feel sure that a bidder and lessee will be secured, and it is their belief that they will be in a position to award the contract in November. It is believed that two years will be occupied in construction work, aside from delays of all kinds.

Formal announcement has been made of the consolidation of the Brooklyn City and Newtown railroad, better known as the De Kalb Avenue road, and the Coney Island and Brooklyn road, long known as the Smith street line. Col. John N. Partridge, president of the De Kalb Avenue line, will probably retain his place, and John L. Heins will continue to serve as secretary and treasurer. It is said that the capital stock of the De Kalb Avenue company has been increased from $1,000,000 to $2,000,000, and the stock of the other company, which had a capital of $1,000,000, has been exchanged for the De Kalb Avenue stock. The consolidate roads will have a mileage of 21 miles and a clear track all the way from North Beach to Coney Island down the old boulevard, starting directly from the rear entrance to the park. It is understood that free transfer stations will be established at all the intersecting points along the lines. With the consolidation of the two companies there will be next summer a direct line from North Beach to Coney Island. The Brooklyn City and Newtown road contemplates building an extension from the present terminus at De Kalb and Hamburg avenues to North Beach. The cars will run in a direct line along Franklin avenue to and around Prospect park, connecting with the present route of the Coney Island and Brooklyn road to the island. The only opposition that has developed thus far was on the part of Patrick H. Flynn, the promoter of the Nassau Electric Railroad company, who was opposed to the organization of the Brooklyn Traction company, which controls the Brooklyn Heights, the Brooklyn City, and Brooklyn, Queens County and Suburban Railroad companies. He is also a stockholder in the Coney Isand and Brooklyn Railroad company. President Partridge notified Mr. Flynn, who owns 346 shares in the Coney Island corporation, that the contract had been entered into. Mr. Flynn said that he would oppose any such consolidation, and his lawyers were instructed to apply for an injunction restraining the consolidation of the two roads. Mr. Flynn said that some time ago the directors of the Brooklyn Traction company offered to purchase the Coney Island and Brooklyn road, and were willing to pay $22 for each share of stock. The offer was not accepted.

Another big consolidation that is as good as completed is the merging of the People's Electric Light and Power company of Newark and the Newark Gas company. Philip N. Jackson, president of the People's company, said, in regard to the terms of the deal, that it would be effected in a way similar to that of a consolidation of the gas and electric light companies of Rochester. The electric light company has a capitalization of $5,000,000, and has issued no bonds. The gas company has $1,000,000 capital stock and $4,000,000 of bonds. The electric light company controls the lighting of nearly 20 towns, and most of the plants in New Jersey, not owned or controlled by the company, are owned or controlled by the United Gas Improvement company of Philadelphia, which has, within a month, secured 2,500 shares of the People's company stock. The Newark Gas company controls the gas lighting in Harrison, Kearney, Montclair and other places, near Newark, while the Philadelphia Gas Improvement company controls the same interests in Jersey City and Paterson. The consolidation, when effected, will, therefore, have control of nearly all the gas and electric lighting interests of Northern New Jersey, and it may eventually embrace the same interests in the entire state. The new consolidation will represent a total stock capitalization of $15,000,000. The present Newark Gas company was formed a year ago by a consolidation of the Citizens' and Newark Gaslight companies. The largest stockholder in the Citizens' company was Henry C. Kelsey, secretary of state, and the largest owner of Newark company stock was Eugene Vanderpool, the president. The stockholders accepted bonds for their stock, paying five per cent. and interest, and $4,000,000 was issued. Mr. Kelsey became president of the new company. The People's Electric Light and Power company is a combination of all the electric light companies in Newark and neighboring towns, and the controlling spirit in it is Bernard M Shanley, who is also one of the principal men of the Consolidated Traction company. E. B. Gaddis and others who are heavily interested in the Consolidated Traction

company, also have large interests in gas and electric light.

The electrical fountain on the Prospect Park plaza in front of the Soldiers' and Sailors' Memorial Arch, is to be one of Brooklyn's attractions. The fountain was designed by F. W. Darlington of Philadelphia, and constructed by the Wilson and Baillie Manufacturing company of Brooklyn. The basin, which is of heavy concrete, with a cement bottom, is 360 feet in circumference, and the high-pressure service from the water tower close by will furnish the fountain 75,000 gallons an hour. The Brooklyn Heights and Nassau Electric trolley companies will supply the necessary power to run the pump and illuminate the fountain free of cost, in anticipation of an increase in the traffic on their cars passing the fountain. In operation there will be 152 colored slides and the flow of water will be so arranged as to secure a variety of displays. While the electrical displays are suspended, the basin itself will be illuminated with 60 incandescent lamps around the base. There will also be 19 automatic focusing arc lamps of 800 candle power each, which can be adjusted by the opertor, so as to illuminate the memorial arch and the picturesque walls surrounding the plaza. The contract price for the fountain was $24,500. M. S.

Western New York.

Niagara Falls, N. Y., August 10.—Judge Buffington, in the United States District Court for the Western District of Pennsylvania, has rendered a decision in the case of the Cowles Electric Smelting and Aluminum company of Lockport against the Carborundum company of Niagara Falls, in favor of the latter company. The patents involved were obtained by E. G. Acheson, who is president of the Carborundum company. The suit was first entered in 1894, and the argument before Justice Buffington was begun on December 7, 1896. It was claimed by Alfred H. Cowles that the electric furnace used was his discovery and that he had made carborundum in 1885. The suit asked for an injunction restraining the Carborundum company from using the furnace. The Carborundum company was among the first enterprises to locate on the lands of the Niagara Falls Power company, and the business grew so rapidly that the factory was very early enlarged. The business of the Monongahela City, Pa., plant was transferred to the Falls, and to-day the furnaces produce on an average 4,200 pounds of carborundum per day. The business has spread to such an extent that plants have been established in Austria and Germany. Canada will have a plant within a year in all likelihood, while the Niagara Falls plant supplies the English and other foreign markets.

Mr. Acheson, president of the Carborundum company, has returned from Germany, where he went to establish a branch of the carborundum business in that country in order to protect the German patent. Mr. Acheson established a factory at Dresden, where a frame building was erected to start with, and made arrangements for 400 electrical horse power to be furnished from the municipal lighting plant of the city. The plant will be operated by a Dresden company, which will supply the German trade with carborundum in bulk. Wheels and other articles of the kind will not be made by the company. While abroad Mr. Acheson arranged an agency in London for the English trade. Orders from England will be filled from the Niagara Falls plant, which will also supply manufactured carborundum for the German trade.

The Cataract Power and Conduit company of Buffalo is busy extending the conduits for the transmission of Niagara power through several more streets in Buffalo. Cables will be laid from Albany street to Niagara, to Court, to Main and to the island. The Main street conduits are already in.

From Old Virginia.

Richmond, August 10.—The electric light company of Newport News is an indispensable institution. The company was organized in 1891 for the purpose of supplying electric light and power to Newport News and vicinity, and since its incorporation has been highly successful. In 1896 it absorbed the Crystal Ice and Refrigerator company and the two are now being conducted by the one corporation. The officers are E. C. Hillyer, president and manager; William B. Vest, treasurer, and J. H. Wickham, secretary. The central station of the company is a substantial brick building 100 by 90 feet, and contains the generating plant. Adjoining is the boiler house, 40 by 96 feet, containing the 600 horse power boilers, while on the adjoining block, covering an area of 175 by 100 feet, are located the ice factory and stables. The lighting plant is a model of its kind and is equipped with three 125 horse power improved Green engines, three Thomson-Houston arc dynamos of 175 lights capacity, and four Edison dynamos of 5,000 lights capacity. The company now has 143 arc lamps and 2,800 incandescent lamps in operation. It also supplies power for manufacturing purposes

The Southern Bell Telephone company's exchange in Danville has until now escaped the opposition fever that has broken out in several of the Virginia cities, but an active effort is now being made to secure a cheaper service. Several prominent business men conceived the idea of protesting, and after a conference with other influential citizens drafted a petition to the telephone company asking that the rates now prevailing be reduced. This paper was numerously signed. The local manager of the telephone exchange, H. O. Eanes, announced that the case would be laid before the district superintendent, C. E. McLuer of Richmond.

The Bell company is without competition in Danville, although in Roanoke, Lynchburg, Norfolk, Alexandria and Richmond rival local companies are fighting the old system, with the result of considerably reducing rates. In Roanoke, for instance, the yearly charge for telephones is $12 now, whereas before the advent of competition the rate was several times that amount. The prevailing rates in Danville are: Business, $40; residence, $30; duplex business, $20; residence, $18. These rates are a reduction from those in force several years ago. The Danville exchange has now about 260 telephones in operation, is giving good service, and apparently is better equipped to give satisfaction than ever before since its establishment. A switchboard of the latest design and of very costly finish was placed there about a year ago at great cost to the company. At the same time other improvements were added.

The Shenandoah County Telephone company is extending its connections.

A mortgage filed on August 3d, was executed by the Falls Road Electric Improvement company to the Maryland Trust company to secure an issue of $552,000 in 50 year five per cent. bonds. All of the property and franchises of the road are pledged.

Charlottesville will profit by Staunton's example in the telephone line. The Chamber of Commerce has taken the matter in hand and will get up a mutual company and furnish service to business houses for $18 and to residences for $12 a year. The company now charges $30 and $24.

A new dynamo has been put in the street railway power house at Staunton, which gives all the needed power to propel the cars at high speed up hill and down. Interest has revived in the project of an electric railway for freight and passenger service from Staunton to Highland county. I. P.

Northwestern Notations.

Minneapolis, August 10.—The breaking of a rod in the power house of the street railway system in Tacoma, Wash., caused the 40 ton fly-wheel to go to pieces and wrecked the buildings and plant, doing $20,000 damage.

The new electric light company at Cedar Falls, Iowa, has been incorporated with $20,000 capital stock. Henry Gilky is president, M. W. Bartlett vice-president, A. Grundy secretary and Roger Leavitt treasurer.

The St. Cloud, Minn., electric street car line will be put at once in repair. The local bondholders have accepted the offer of the eastern bondholders, who now own all the stock. The system will be taken out of the receiver's hands as soon as possible.

Harold V. Smith of Marion county, Ind., who is connected with the Western Electric company of Chicago, was married at Redwood Falls, Minn., to Marion L. Everett.

John I. Wilson, George A. Cutting and E. G. Nourse of Winona, Minn., are applicants for an electric light franchise in that city.

The Mason City & Clear Lake Traction company has completed its electric line between Mason City and Clear Lake, Iowa, and has it in operation.

The Citizens' Traction company of Oshkosh, Wis., will establish a system of 'buses on the south side of the city to compete with the horse cars in that section.

Minneapolis aldermen are considering utilizing the trolley system for street sprinkling.

William Russell of Inkster, N. D., has bought the Pembina, N. D., electric light plant.

The survey for the electric line between Eau Claire and Chippewa Falls, Wis., for the Chippewa Valley Railway company, has been about completed.

Harry Sterling is making efforts to secure an electric light plant for Huron, S. D.

Adams, Green & Co. of Morrison, Ill., secured the contract to install an electric light plant in Eldon, Ia.

Eagle River, Wis., will vote July 31st on granting F. J. Thrun a franchise for electric lighting.

The Electrical Machinery company of Minneapolis secured the contract to install an electric light plant at Valley City, N. D., from plans by W. I. Gray & Co. of Minneapolis.

The new electric lighting company of Cedar Falls, Ia., has let the contract for a dynamo to the Westinghouse company.

The Little Falls, Minn., Electric & Water company has ordered a new Brush dynamo for its light plant.

The Belle City street railway of Racine, Wis., was sold by the receiver to Frank J. Miller, representing the bondholders of the road, for $150,000. A new company will be organized to take charge of the line.

J. A. Brown of Moline, Ill., has invented an automatic fire alarm for covering the business portion of the city. It is to be attached to the ceiling and is so sensitive to heat that a bucket of burning shavings will cause an alarm.

West Liberty, Ia., voted to install an electric light plant.

The Patten street railway system is being tested in Stillwater, Minn. It is said to be much more economical than the overhead wire system.

The city of Mankato, Minn., is taking bids for furnishing electric lights for the streets for five years.

As soon as the Barnes Electric Light and Power company of Maquoketa, Ia., completes its dam it will extend wires to Delmar, Ia., and furnish light for that place.

The Fox River Valley Railroad company has been incorporated at Milwaukee, Wis., to build an electric line from Neenah to Appleton, Wis., and later to Kaukauna.

The electric light plant at Woodstock, Minn., has been completed and put in operation.

The West Algoma street branch of the Citizens' Traction company's system in Oshkosh, Wis., has been completed and put in operation.

The Janesville Electric Light and Power company of Janesville, Wis., has been incorporated with $25,000 capital stock to furnish lighting for stores and private residences. The plant is to be put in at once.

W. D. Lewis, manager of the Western Union Telegraph company office at Green Bay, Wis., who was drowned recently, has been succeeded as manager by Mr. Elliott of Escanaba.

L. A. Seamans is in charge of the North American Telegraph company's office at La Crosse, Wis., succeeding F. W. Robbins.

Osage, Ia., rejoices in the return of electric lighting. The dam supplying power went out this spring with the high water and has just been rebuilt.

The city of Spokane, Wash., has doubled the number of arc lights it will use in lighting its streets after September 1st.

The Grand Forks Gas and Electric Light company bas withdrawn its suit against the city of East Grand Forks, Minn., to collect $11,000 alleged to be due for lighting. The company will take the suit into the United States Circuit Court at once.

Work has been begun on the electric line of the Fox River Valley Electric railway at Appleton, Wis. The line to Neenah will be built first.

Work will shortly be begun on the electric light plant of the Chatfield Electric Light company.

Snapp & Reid & Co. contemplate putting in an electric light plant in Carson, Ia., for street lighting.

There is a project at Carroll, Ia., to furnish current for electric lighting at Glidden, Ia., from the Carroll plant.

The City Council committee has recommended the acceptance of the bid of the Minneapolis General Electric company for lighting the streets of Minneapolis after January 1, 1898. The company agrees to furnish 200 lamps all night and 600 on moonlight schedule, for $118 and $100 per year respectively. At present the company is getting practically the same figure for furnishing 100 less lights.

The electrical inspector of St. Paul in his first report says the ordinance will be strictly enforced and all dead wires ordered down. He has been at work since July 7th only, but has found 112 dead wires in the business district, which have been ordered removed.

The village of Barnesville, Minn., will vote on a new charter which will permit the issue of bonds for electric lighting.

The council of Madison, S D., has rejected all bids for furnishing an electric light plant, and will take new bids on revised specifications for furnishing a system employing direct-connected machinery.

Telegraph connection between Wardner, Ft. Steele, Idaho, and Kalispell, Mont., will soon be established.

The contract was let at Marquette, Mich., for furnishing 2,022 feet of steel flume for the city lighting plant, to the Muskegon Boiler Works for $13,092.

Bankson Taylor of St. Paul has made a proposition to build an electric street car line in Mankato, Minn.

The city of Madison, S. D., let the contract for an electric light plant to the National Electric company for $6,282.

J. K. Tillotson of the Citizens' Traction company of Oshkosh, Wis., is the author of several plays, and is now negotiating with several companies to produce them in Oshkosh. C.

Canadian News.

Ottawa, August 10.—A new company has been organized in this city called the Dominion Electric Heating and Supply company, and will commence operations very shortly. Andrew Holland is the president and J. I. MacCraken, secretary and treasurer. The object of the company is to supply heat at a much lower figure than the present rate. The company intends to commence by supplying heat for domestic utensils, such as flat-irons, cooking appliances, etc., and gradually extend to car heating, and in the end to house heating. The intention of the company is to establish workshops here on a small scale and, if results warrant, to extend them considerably and erect a large factory.

The contracts for the plant in connection with the Sherbrook Street railway have been let. The specifications for the cars call for the very latest improvements. Electric heating will be adopted. There will be two motors on each car, giving 70 horse power. The work on the power house is being rapidly pushed, and every effort is being made to have construction work completed at the earliest possible moment.

The city of Toronto has recently complained to

the electric light company regarding the nuisance caused by smoke from the company's plant, in consequence of which the company is now considering plans of several smoke-consuming appliances.

A. V. W.

PERSONAL.

William Wright has resigned his position as manager of the Chicago Armature company and has taken the general western agency for the E. G. Bernard Electric company of Troy, N. Y., manufacturer of dynamos and motors and electrical supplies, with offices at 939 Monadnock building, Chicago.

C. C. Haskins, who for 13½ years has been employed by the Chicago city government as electrical inspector, has severed his connection with the municipal corporation, and opened an office at 623 Western Union building, as an electrical expert. Mr. Haskins' claims to the title are based on a thorough theoretical and practical knowledge of electrical applications, commencing with telegraphy in its earliest days, passing through its various phases, then several years of telephone experience, and finally, an electric light schooling as inspector.

Thomas B. Dixon, whose system of sextuplex telegraphy was tried in Boston recently, is a Kentuckian by birth, although he has lived for several years in New York. He is 32 years old, and is the youngest son of Archibald Dixon who succeeded Henry Clay in the Senate in 1852, and was at one time governor of Kentucky. It is related of the inventor that when he was only 12 years old he lost his arm while hunting, but that did not prevent his becoming an exceptionally good performer on the piano. Mr. Dixon also plays the guitar well. Part of his youth was spent in Germany, where he continued the studies begun in this country.

ELECTRIC LIGHTING.

H. W. Lackey & Co. of Gilman, Ill., contemplate installing an electric light plant, and would be pleased to hear from dealers in electrical machinery.

Mayor Ross of Terre Haute has refused to sign the order for the payment of $2,199 to the electric company for street lighting during July, on the ground that the company owes the city $4,944 back taxes and $8,415 for street improvements. Russell Harrison is president of the local street railway company, and a year or so ago he organized a lighting company, whose plant is operated in connection with the trolley system. Mayor Ross says that Harrison transferred the franchises, good-will, etc., of the lighting company to the street railway corporation to avoid meeting his obligation to the city. President Harrison says he has a right to delay in the payment on the street improvements because, under the law passed at the last session of the Legislature, street railway companies were given the same terms as abutting property owners for the payment for the paving of streets, which is 10 years, in annual installments.

ELECTRIC RAILWAYS.

Trolley parties are popular with the mighty as well as the lowly in Massachusetts. Here are some of the names of those who enjoyed a 60 mile run on last Saturday: Senator George F. Hoar, Colonel E. B. Stoddard, Dr. Thomas C. Mendenhall, Nathaniel Payne, Colonel E. B. Glasgow, General Rockwood, Charles F. Aldrich, Henry A. Marsh, M. V. B. Jefferson, Colonel Theodore S. Johnson and Samuel R. Heywood. The party was gotten up by Senator Hoar. The start was made at Scollay Square, Boston, and the route took in Swampscott, Lynn, Salem and Gloucester, where dinner was served.

The Metropolitan Traction company claims to have financed its first mortgage bonds. By terms entered into with the Equitable Trust company it has secured $2,000,000 with which to begin construction. The mortgage trust deed for $2,000,000 was filed for record last Wednesday morning in favor of the Equitable Trust company as trustee, and the State Trust company as co-trustee. The bonds are 2,000 in number, and run 30 years at five per cent. interest. The funds secured by this mortgage will be used to build and equip the first sections of the road, which the officers promise will be in partial operation by March 1st. The charter under which the company received permission to build its 200 miles of roadbed was only granted two months ago by the Cook County board. The contest to secure the charter was memorable because of the stubborn wrangles which it precipitated. The same interests back of the Metropolitan Traction are also back of the Chicago General Electric Railway company. For this reason conservative men look upon the plan with distrust.

Lake Street "L" is now being regarded by the Chicago investors as a thermometer, registering the temperature of the controllers of the Union Elevated loop as it varies in the negotiations for the Metropolitan and Alley "L" contracts. The Metropolitan company was ready to sign its loop agreement, but was delayed by the refusal of the South Side Elevated company to meet the terms imposed by Mr. Yerkes. It is said that the loop company wishes a larger compensation than that demanded in the original document, but the south side road is unwilling to agree to such a payment. There is also some difference with reference to the proportionate expense of operating the loop. The Northwestern "L" will not be completed for at least a year from the time work is resumed on its structure, and in the interim Mr. Yerkes does not desire to pay one-fourth of the cost of maintaining and operating the loop, as it is provided under the original loop contract. The result of this parrying is expected to be adjustment on the original lines, for without the south side road the loop company will be placed in an embarrassing position, while the Alley "L" can get along without the loop.

TELEPHONE.

Charles A. Grant, treasurer of the Erie Telegraph and Telephone company, announces that a quarterly dividend of one per cent. will be paid by check mailed to stockholders, August 16th. The stock-books were closed at noon, August 7th, and will be opened on Monday morning, August 16th.

The Interstate Telephone company of Central Illinois, with headquarters at Tuscola, has recently completed re-equipping its entire system. The company has probably one of the largest and best paying toll line systems in the independent telephone business. These lines connect Decatur, Moroa, Clinton, Monticello, Vorhies, Champaign, Chrisman, Oakland, Arcola and all intermediate towns with Tuscola. The central station at the latter place and the toll lines are now equipped throughout with apparatus and special switching and testing equipment made by the Stromberg-Carlson Telephone Manufacturing company of Chicago. It is said the service given is satisfactory, and that the company's business is steadily increasing since the change.

TELEGRAPH.

Press dispatches from Boston announce that on August 2d a sextuplex telegraphic wire was successfully operated there in the presence of representatives of New York and Boston newspapers. The circuit was to New Haven and return, a distance of 300 miles. Three different messages were sent over the wire simultaneously, and were easily and accurately received on the receiving sides. The inventor is Thomas B. Dixon of Kentucky.

Recent news from London is to the effect that the attitude of the postoffice telegraphers is becoming threatening. The answer of the postmaster-general, the duke of Norfolk, to their demands is not forthcoming, and if the telegraph operators carry out their threats, an almost complete stoppage of the service is probable. The delays in the transmission of messages are already scandalous. The financial secretary to the treasury, R. W. Hanbury, in the House of Commons last week, explained that the delay was due to motives of economy. The newspapers throughout the country are most scathing in their comments on the mismanagement of the postoffice.

Telegraph companies, other than the Western Union Telegraph company, shall be allowed to charge and collect 20 cents for a message of 10 words or under, exclusive of date, address and signature, between any two points within the limits of Virginia, and not more than one cent for each additional word. Whenever a message is sent over two or more telegraph lines owned, controlled and operated by two distinct corporations or individuals, the joint rate shall not exceed 30 cents for each message of 10 words or less, exclusive of date, address and signature, between any two points within the limits of the state, nor more than one cent for each additional word.

A commercially practicable submarine cable for telephonic and rapid telegraphic messages, in which electrostatic capacity is reduced to a minimum by the substitution of air for gutta-percha between the conductors, has been made for the English post-office department by the Telegraph Construction and Maintenance company, and has recently been laid in the Solent. The cable was designed by Willoughby Smith and W. P. Granville, and may be regarded as to some extent a practical outcome of the telephone submarine cable designed by Mr. Preece and described by him at the British association meeting last year. In Mr. Preece's cable two semi-circular conductors were separated by paper insulation, while in the new cable now laid in the Solent paper is not used, the space between the four wires being filled with air, except in so far as it is occuped by a certain amount of gutta-percha necessary to hold the wires in place. Thus the new cable is literally a hollow tube, which, however, is stopped up at intervals by partitions that divide the air space into water-tight compartments.

J. Henniker Heaton and Horace Plunkett, members of the House of Commons, have sent a letter to the president and directors of the Anglo-American Telegrah company, and the Western Union Telegraph company, congratulating the companies on their arrangements for the chess contest between the House of Commons and the House of Representatives on May 31st and June 1st. "The absolute accuracy and rapidity of the transmission was," the letter says, "'simply amazing,' to use the words of our generous rivals across the Atlantic. There was not a single error during the match, and the distance of over 4,000 miles did not perceptibly impede the progress of the games." A brochure has been issued, giving quotations from press notices of the game. The English papers of June 1st said that one move at 10 o'clock was received in Washington, and the answering move recorded in 40 seconds. Another move and a reply occupied 13¼ seconds, this being considered a record in telegraphing by cable. Thirty-six moves (18 moves each side) were transmitted in 75 minutes, including the time occupied by the players—a feat which evoked a cable message saying: "Washington simply amazed at rapid transit."

MISCELLANEOUS.

Bids were opened by the United States government, Tuesday, August 3d, for a large equipment of machinery for the navy yards at Port Royal, S. C. The Davis and Egan Machine Tool company of Cincinnati was awarded the contract for several of the machine tools.

Commenting upon recent contracts noticed in these columns, the New York Tribune says: "English journals are as much excited over the purchase of American electrical machinery for the London railroads as if England were not a free-trade country which was always preaching to us how much better it would be for us to buy our manufactured goods abroad."

An observation tower, recently opened to the public, is a permanent addition to the seaside attractions of Great Yarmouth, England. The structure is 125 feet in height, and is built entirely of steel on concrete foundations. Including the machinery, it weighs about 125 tons. A circular platform built round the tower, and constructed to accommodate about 160 passengers, is raised to the summit and lowered by means of steam power. As it ascends, the platform is revolved by electric motors at the rate of one revolution in three minutes. There is another platform at the summit, to which access is obtained from the revolving apparatus, and which is hoisted to an additional height of about 20 feet. At night the structure is illuminated by 50 incandescent electric lights and by three arc lights.

In the course of some observations reported in the Journal of the Chemical Society, M. Moissan found that diamonds which had been subjected to molecular bombardment in a Crookes tube were completely blackened on the surface, and after prolonged treatment with nitric acid and potassium chlorate yielded graphitic oxide, which when heated changed into pyrographitic acid. The graphite was very slowly oxidized, and in this respect behaved like graphite formed at a high temperature. After four treatments with the oxidizing mixture, the diamonds were still covered with a maroon-brown film of finely-divided carbon. Since diamond is not converted into graphite in the oxy-hydrogen blowpipe, it is clear that the molecular bombardment must produce a temperature which exceeds 2,000 degrees. The behavior of the graphite is said to indicate that it was formed at a temperature similar to that of the electric arc.

TRADE NEWS.

F. W. Horne, formerly identified with the electrical trade, has placed a large order for lathes, planers, shapers, milling machines, etc., with the Davis and Egan Machine Tool company of Cincinnati, for shipment to Japan. He will represent that company in China and Japan.

The popularity of apparatus furnished by the Ahlm-Edwards Electric company of Cleveland, is attested by the orders received recently by that concern. The company has supplied several equipments for printing plants and the operation of elevators, in addition to lighting and general power plants.

"Four of a kind"—a good hand in any game, is unusually strong when backed by such a concern as the American Electrical Heater company of Detroit. The cards which this company is playing announce the superiority of the electric soldering iron for telephone exchanges, electric tailors' irons, electric curling iron heaters and electric laundry irons, which it is putting on the market.

BUSINESS.

The Electric Arc Light company of New York is being favored to such an extent that it is compelled to add still more to its facilities. The increase in the cost of carbons in the new tariff is adding to the prospects of this company, as the increased economy of the inclosed arc is made more prominent.

Walter C. McKinlock has opened an office in the Fort Dearborn building, Chicago, to handle a general line of electrical merchandise, and he is now arranging for agencies. He has had 15 years' experience on the road and has a large personal acquaintance with station superintendents and owners, and electrical contractors in Chicago and through out the West.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued August 3, 1897.

587,296. Electric Bale Tie Machine. William O. Bates and William J. Hutchins, Joliet, Ill. Application filed March 8, 1897.

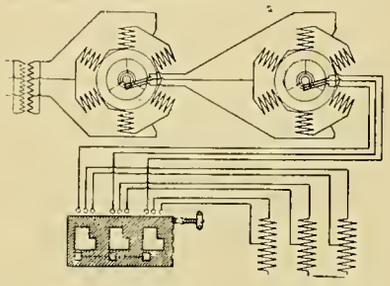
An electric welding attachment is included in a machine for the manufacture of bale ties, arranged to grasp the coinciding wire parts of the loop or loops during a period of time sufficient to electrically weld the coinciding parts together.

587,311. Regulating Admission of Currents to Motors. Frank E. Herdman, Winnetka, Ill. Application filed November 27, 1896.

The device is adapted in its movement to vary the amount of current passing to the motor, and means are connected with and operated by the motor to normally control the position of the current-regulating device.

587,336. Telegraphy. Franc M. Short, Cleveland, Ohio. Application filed April 9, 1896.

The apparatus employed includes a transmitting instrument, comprising insulated points, one of the points included in circuit with a source of current, and the other included in circuit with the line wire, the circuit between the points adapted to be closed by the conducting material composing the message design or the like to be transmitted, a receiving instrument comprising a vibrating recording style, and means energized by the current of the line circuit for vibrating the style.



NO. 587,340.

587,340. Operating Alternating Motors. Charles P. Steinmetz, Lynn, Mass. Application filed November 23, 1893.

The method described consists in feeding alternating currents to one member of one such motor from a source of power supply, converting the energy so supplied to the motor partly into mechanical energy expended in driving the mechanism, and partly into electrical energy in the form of alternating currents induced in the secondary element of the motor, and supplying a second alternating motor with the secondary currents.

587,343. Electric Furnace. George S. Strong, New York, N. Y. Application filed January 20, 1896.

The improvement recorded in the art of electric smelting consists in forming electrodes of a mass of material including a material which will bind the mass together under pressure and simultaneously agglomerating, forming and feeding the mixture forward to a furnace by pressure.

587,379. Dynamo Electric Machine. Ernest P. Warner and Henry H. Wait, Chicago, Ill. Application filed June 3, 1896.

A pole piece is provided with one or more slots, narrow at the pole face and of increased width at portions removed from the face of the pole piece, to thus leave constricted necks or paths between the face of the pole piece and the remaining portions of the field magnet circuit to prevent the formation of a local magnetic field.

587,405. Signal for Telephone Switchboards. Charles E. Scribner, Chicago, Ill. Application filed August 1, 1895.

Two terminal plugs of a pair and the plug circuit thereof, means for connecting a generator of signaling current with one of the plugs, a bridge of the plug circuit, a source of current and a signal in the bridge, and another signal included in a conductor of the plug circuit between the bridge and that plug with which the generator of signaling current may be connected.

587,406. Apparatus for Telephone Switchboards. Charles E. Scribner, Chicago, Ill. Application filed December 18, 1896.

A source of current in the line, and means at the substation for determining the flow of current consequent on the use of the telephone, a line signal associated with the line in the central office and controlled by currents in the line, a relay adapted to break the circuit through the signal when excited, a local circuit including the relay, and means for closing the local circuit in the act of making connection with the line, whereby the line signal is effaced when connection is made with the line.

587,421. Electric Arc Lamp. Sigmund Bergmann, New York, and Erwin Lavens, Brooklyn, N. Y. Application filed February 7, 1896.

A globe is closed at the bottom and has an aperture at the top, and a cap for the aperture is adapted to fit the upper carbon, and is provided with a depending flange slightly smaller in diameter than the aperture, permitting lateral play of the carbon while holding the cap in place.

587,433. Electric Signaling Apparatus. Mortimer Du Perow, Washington, D. C. Application filed July 10, 1895.

The normally open partial speaking circuit having in it a telephone, or the primary and secondary coils thereof, and the independent normally open partial signal transmitting circuit having in it a source of electricity are combined with the independent partial signal receiving circuit, having in it a signal and being normally closed by a switch adapted when moved in one direction to successively open the signal receiving circuit, close and then open the signal transmitting circuit, and finally close the speaking circuit, and when moved back again to reverse these operations.

587,435. Automatic Telephone System. Moise Freudenberg, Paris, France. Application filed October 22, 1896.

One feature is a counter composed of a series of wheels provided with adjustable arms, switch points and connection for completing a circuit through the arms in series, and an electro-magnet operating means for turning the wheels.

587,436. Electro-therapeutic Apparatus. Frederick Geiger, Philadelphia, Pa. Application filed May 13, 1897.

This includes a main circuit, a patient or operator circuit, a fixed resistance in series with the operator circuit, and a variable resistance in the main circuit and in shunt with the patient or operator circuit.

587,437. Apparatus for Manufacturing Chlorate of Potash by Electrolysis. Ferdinand Hurter, Liverpool, England. Application filed May 8, 1897. Patented in England August 12, 1893.

A cathode consisting of a metallic vessel having a porous protective lining, is employed.

587,441. Regulating Apparatus for Electrically Driven Mechanism. Walter H. Knight, Newton, and William B. Potter, Lynn, Mass. Application filed May 21, 1892.

A switch is used for placing the motors successively in series and multiple, magnetic pole pieces adjacent to the several contact plates of the switch, and a common magnetic core for energizing the pole pieces.

587,442. Method of Regulating Electrically Driven Mechanism. Walter H. Knight, Newton, and William B. Potter, Lynn, Mass. Application filed May 21, 1892.

A resistance is inserted, disconnecting one motor so as to leave the other motor in series with the resistance, and then connecting them both in multiple.

587,458. Electric Switch. Herbert W. Smith, Pittsfield, Mass. Application filed May 5, 1897.

An electric switch terminal, comprising a block, an undercut recess therein, a contact plate bent to correspond substantially with the recess, and a pin adjacent to the bend and within the recess to secure the plate in place in the recess.

587,465. Electric Arc Lamp. Edwin F. Taylor, West Chester, Pa. Application filed March 18, 1896.

A chimney for electric arc lamps has a plate adapted to close its top, the plate having orifices symmetrically disposed about its center, a chamber into which the orifices open, an escape passage leading from the chamber to the air, and means for closing the bottom of the chimney adapted to have only a contracted opening thereto.

587,467. Telephone Central Station Signaling Circuit. George K. Thompson, Malden, Mass. Application filed May 25, 1897.

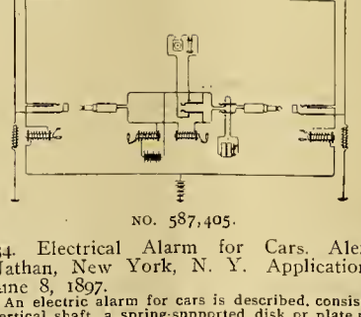
The combination is claimed in a telephone central station apparatus of a series or group of connecting cords or conductors, a corresponding series of disconnecting lamp signals, a shunt circuit round each signal, an electro-magnetic switch controlling each shunt circuit, and a common supplementary or pilot signal in an auxiliary local circuit, with a relay controlling such auxiliary local circuit and pilot lamp, and wound with a plurality of exciting coils associated with the cords and disconnecting signals respectively, the coils or windings being each connected in parallel with its associated lamp, and sustaining like relations with the lamp to the shunt circuit thereof and its controlling switch.

587,502. Central Office Switchboard System. William S. Harrison and Edward M. Harrison, Chicago, Ill. Application filed March 30, 1895.

Polarized annunciators, spring-jack switches and companion switch plugs, one plug being insulated on the upper surface and the other in the under surface for cutting one annunciator into circuit and the other annunciator out of circuit, are described.

587,507. Electric Signal Device for Elevators. Otto Raacke and Gustav Hensel, St. Louis, Mo. Application filed March 11, 1897.

A suitable spring plate is adapted to be movably secured to either the elevator or shaft; means are provided for cooperating with the spring plate during the travel of the elevator in one direction for shifting the plate, whereby the normal relation is disturbed, and thus depress the free end of the circuit closing arm, bringing the end into connection with the opposite pole of the circuit, and thereby sounding an alarm.



NO. 587,405.

587,534. Electrical Alarm for Cars. Alexander Nathan, New York, N. Y. Application filed June 8, 1897.

An electric alarm for cars is described, consisting of a vertical shaft, a spring-supported disk or plate mounted thereon, and insulated therefrom by means of a sleeve, a disk or plate connected with the lower end of the sleeve, another disk or plate mounted on the shaft below the last-named disk or plate and insulated from the shaft, and an electric bell in circuit with the last-named disks or plates.

587,531. Electric Motor or Dynamo Electric Machine. Robert Lundell, Brooklyn, N. Y. Application filed December 15, 1896.

The machine has a rotary armature and a field magnet composed of duplicate or interchangeable parts, with overlapping field-magnet poles surrounded by an energizing coil inclined at an angle to the axis of the armature, and permitting of removal thereof without disturbing the field magnet.

587,565. Electric Signal Box. Albert T. Whittlesey and Frederick B. Dodge, Cleveland, Ohio. Application filed June 18, 1896.

This device consists of a mechanical movement-releasing device consisting of a lever engaging the movement when in its normal position, the lever being pivoted to and carried by another pivoted lever, whereby the movement-engaging lever is released to send in special signals by the operation of the lever to which the movement lever is pivoted.

587,568. Electrolytic Heating Apparatus. George D. Burton, Boston, Mass. Application filed February 24, 1897.

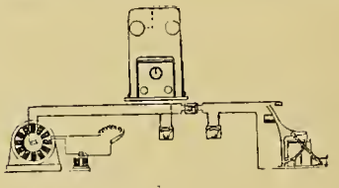
An improved soldering apparatus, consisting of a tank provided with an electrode adapted to contact with the contents of the tank, in combination with a second electrode adjacent to the tank, a horizontally and vertically adjustable rest adjacent to the second electrode.

587,573. Dynamo-electric Machine. Valere A. Fynn, Erith, England. Application filed August 3, 1896. Patented in England December 20, 1895.

There is the combination of an armature composed of two laminated rings or sections, and a field magnet having its two sets of poles arranged alternately in different planes transversely of the shaft, the poles of the same polarity acting upon the same armature ring or section.

587,576. Dynamo-electric Machine. Charles M. Green, Cleveland, Ohio. Application filed November 10, 1896.

In a multipolar dynamo machine, the combination is claimed with a series of commutator rings, of armature coils connected with commutator segments at the same side of the armature at which the coils are located, and several sets of commutator brushes to engage the commutator rings.



NO. 587,649.

587,593. Telephone Transmitter. Owen Moran, New York, N. Y. Application filed December 22, 1896.

One claim is given: In a telephone transmitter, the combination with the casing, the cap fitted thereon having a suitable mouth-piece, and with the diaphragm between said casing and cap, of the carbon block within the casing having a central hole extending therethrough for the reception of granules of carbon or other conducting material in a loose state, a set-screw extending through the bottom of the casing upwardly into said hole of the carbon block to form a support, and adjusting medium for the loose granules and a carbon pencil extending downwardly from the diaphragm into said hole of the carbon block to contact with granules.

587,594. Electric Contact. Arthur J. Moxham, Lorain, Ohio. Application filed January 28, 1897.

A metallic cover-plate having a perforation and upward projections on each side thereof, with the contact secured in the perforation, but insulated from the projections.

587,614. Electric Wire Holder. Charlie J. Stram, Waterman, Ill. Application filed May 27, 1897.

A holder is described, consisting of a piece of rubber or analogous material provided with an opening therein, and a support for the holder having embracing tongues and a supporting lip.

587,642. Electric Contact Box. William M. Brown, Johnstown, Pa. Application filed September 30, 1896.

A switching mechanism for electric contact boxes comprises the combination with a fixed contact and a contact-carrying armature, of a spring encircling and secured to the armature and to a fixed portion of the mechanism.

587,654. Telephone Transmitter. Oscar A. Enholm, New York N. Y. Application filed November 17, 1896.

A composition of an adhesive elastic substance is intermixed with conducting material, interposed between two electrodes.

587,649. Electrocution Chair. Edwin F. Davis, West Caton, N. Y. Application filed January 6, 1897.

Means are provided for registering the physical condition of the person seated in the chair, a generator and a rheostat for varying the voltage of electrical current produced by the machine, a switch for making and breaking a circuit of the machine, and means for putting a person seated in the chair in circuit with the machine.

587,663. Telautograph. George S. Tiffany, Highland Park, Ill. Application filed June 7, 1895.

Two magnets are used, one for raising and one for lowering the transmitting pen; an armature lever is provided with armatures for the magnets and carries the pen-lifter, the armature lever being pivoted upon and supported by a second lever carrying a make and break, and a paper-shifting magnet of which the circuit is controlled by the make and break.

587,669. Burglar Alarm System. William T. Arnold, Chicago, Ill. Application filed December 15, 1896.

Apparatus at each subscriber's station is connected with the central office to respond upon a change in the condition of the circuit at the subscribers' stations.

587,674. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa. Application filed October 1, 1891.

A bared working conductor extends along the railway, and is divided into two or more sections insulated from each other; an insulated supply conductor is buried or arranged below the level of the track and connected at intervals with the sections of working conductor, a return circuit, and a source of electric energy for supplying current to the insulated supply conductor and return circuit.

REISSUE.

11,624. Coating Metals by Electrolysis. Hans Alexander, Berlin, Germany. Application filed June 18, 1897. Original No. 563,723, dated July 14, 1896.

An electrolytic bath for coating metals is composed of a solution of from five to eight parts of commercial chloride of aluminium containing free acid in one hundred parts of water, and of so much of reguline coating metal as will dissolve therein while the bath is heated to the boiling point, and from two-tenths to three-tenths of a part of chloride of the coating metal.

Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, AUGUST 21, 1897. No. 8

Illumination of College Buildings by Acetylene.

By Orrin E. Dunlap.

The recognition that acetylene gas is winning as an illuminant of great merit is well displayed in its adoption for lighting the great college buildings of Niagara University and Seminary of Our Lady of Angels at Niagara Falls. This college was founded in 1856, and has won a place among the great educational institutions of the country, Very Rev. P. MacHale, C. M., being president. For nearly a quarter of a century the college has maintained a crude oil gas plant, owing to the fact that it is situated some distance beyond the city limits. This gas plant was very satisfactory in its workings, but it hardly answered the increasing needs of the institution. In contemplation of making a change, the college management gave Rev. Father Hayden power to investigate other systems of lighting, and to install a new plant of any knd he deemed advisable. Father Hayden visited Philadelphia and witnessed experiments with acetylene, and was so well pleased with the new gas that he at once ordered the necessary plant, which has since been installed. To-day the faculty of the college has the pleasure of knowing that its institution is probably the largest in the world lighted by acetylene.

The old crude oil plant (Fig. 4) was located in a stone building (Fig. 2) about 100 feet from the main buildings of the college (Fig. 1), and it is in the same building the acetylene generators (Fig. 3) have been placed. They are of the Dolan patent, and a half-inch pipe connects them with the buildings to which the gas is supplied. From October to April about 2,000 feet of gas have been consumed each night heretofore, and it is expected that the cost of operating the acetylene plant will be about one-third of the cost of the oil plant.

The burners in use are of the half-foot pattern. In the main building there are 197 lights; in the chapel, 34; in the postoffice building, 40; in the printing office, the home of the Niagara Index, the college paper, 12, and in the engine room, four. Of the crude oil gas burners in the study room they had 32, whereas they have now only eight acetylene burners, and on these it has been found necessary to put shades, owing to the brilliancy of the light. Before the door of the gas house, as shown in the illustration, are to be seen two of the drums in which the carbide of calcium is shipped, each drum containing about 1,100 pounds. The fact that the carbide is manufactured at Niagara Falls makes it very easy for the college to obtain its material for making gas.

The adoption of this system of lighting by the university has attracted some little attention, because it is the first building of any size in Western New York to use acetylene. However, since the plant has been in operation the new illuminant has given satisfaction, and the college fraternity commend Father Hayden's judgment in adopting the system. It is not all unlikely that other large institutions in the Niagara district will take advantage of this experience, many personal visits having been made to the college to see it in use. For lighting isolated institutions like Niagara University, acetylene would seem to possess many desirable qualities. About the only attention the Niagara University plant requires is to have somebody visit the gas house and turn the crank to agitate the carbide in the generators. In the case of the university the new installation has done away with the services of an attendant at the gas house. The Acetylene Light, Heat and Power company is well pleased with the showing the gas makes at the university.

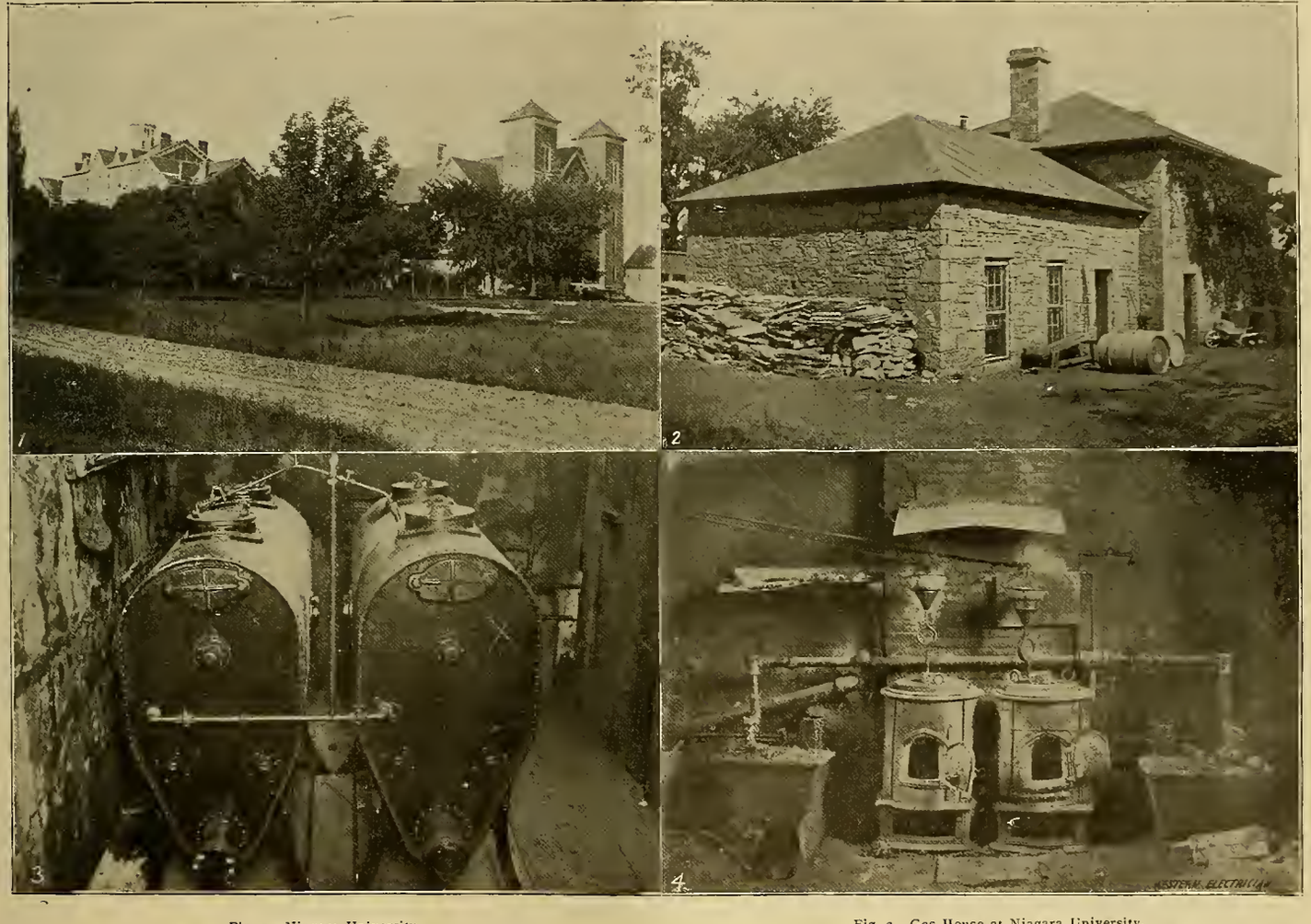


Fig. 1. Niagara University.
Fig. 2. Gas House at Niagara University.
Fig. 3. Acetylene Gas Generators Used at Niagara University.
Fig. 4. Old Crude Oil Plant Supplanted by Acetylene.

ILLUMINATION OF COLLEGE BUILDINGS BY ACETYLENE.

Chilton, Wis., is about to put in an electric light plant.

Chicago City Railway Company's Plans.

It was announced last Saturday that General Manager Bowen of the Chicago City Railway company had stated that the wages of cable-car employes would not be cut at present. Mr. Bowen says that the directors have not yet decided upon substituting the trolley for the cable on State street and Cottage Grove avenue. He has been examining the question and has prepared a report which will be submitted to the directors when they take up the subject. Until they pass upon it, however, nothing will be done toward changing the motive power.

An interesting contribution to the wage question, signed "Cable Driver," appeared in the Chicago Record of Wednesday. It outlines a compromise and may have emanated from the company, although ostensibly written by an employe. Following is the substance of the letter:

Of course paying cable men 30 cents an hour and trolley men 21 cents an hour seems out of proportion. We contend that the trolley men are underpaid, and the officials contend that the cable men are overpaid. We want a leveling up and they want a leveling down. Twenty-one cents an hour was the pay of the conductors and drivers on the horse cars. When the system was changed to electricity the pay remained the same, but the change enabled the company to get out of one man the work of two, or, rather, made one man do twice as much work in a given time, so that all the profit from electrical invention went to capital. Let me illustrate by a case in point: A horse car running on Thirty-ninth street, between the stock yards and Cottage Grove avenue, made 20 trips a day, and took in an average of $20 cash for 12 hours' work. A trolley car in the same time makes 40 trips and takes in an average of $45 cash and 700 transfers. I need not point out that the labor of handling 1,600 passengers is twice that of handling 700, in addition to which the conductor must run 80 times to signal his car across the railroad tracks between State street and the yards, where formerly he ran only 40 times. Nor is this all. By putting trailers on the Wentworth avenue motors the company is able to get out of one motorman the same work that formerly was performed by four horse-car drivers. Now, the reverse process has been going on on the cable road. These men formerly were paid by the trip, computed at 25 cents an hour, but the company found it necessary to shorten the time by taking out the slow loops, so that the trip

from Lake street to Oakwoods, that formerly occupied 60 minutes, can now be made in 50. Let Mr. Wheeler do the fair thing and make it 25 cents all round.

Owing to the large number of bicycle riders using Jackson boulevard, recently paved with asphalt, General Manager Bowen has ordered all drivers of north-and-south cars to come to a full stop in approaching that street and then to proceed over the boulevard at a rate of speed not to exceed four miles an hour. This is an important recognition of the rights of the cyclists.

220 Volt Lamps.[1]

By G. D. Sheparoson.

The high voltage incandescent lamp has been attracting an increasing amount of attention during the last four or five years. Much has been said and written about them, but there is an almost total absence of definite information regarding their performance. As much of the pioneer work in the adoption and development of the 220 volt system has been done in the Northwest, it is fitting that the first public report of accurate commercial tests of the lamps should be made before the Northwestern Electrical association.

Prior to 1893, the literature concerning high-voltage lamps was exceedingly meager and was confined principally to accounts of efforts and hopes of experimenters to bring out a commercial article. The paper read at the St. Paul meeting of this association seems to have marked the beginning of the active introduction of the high-voltage lamp in the Northwest and probably in the world. Since that time a considerable number of plants have been installed.

Many difficulties were encountered at first. Lamp manufacturers attempted to make 220 volt lamps as soon as the contractors forced a market upon them, but one after another gave up in despair until only two or three companies ventured to send out such lamps. They could be had only on special order and usually only after waiting an indefinite time. Lamps from one factory would not operate successfully on the same circuits with

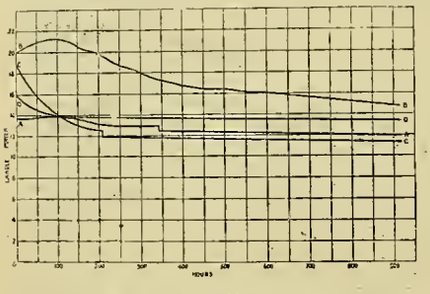


FIG. 1. 220 VOLT LAMPS.

those from another factory, and frequently not with those from the same factory on subsequent order, since some were 20 candle power and some 16; some were for 215 and others for 230 volts, although all were marked " 16 C. P., 220 V." Many of the lamps exploded when first put into circuit, and the loops of the filaments of others touched and short-circuited or bent over and cracked the globe when switched on and off with key sockets.

These difficulties have been overcome to a large extent; the business has increased so that the lamp makers can sort their lamps better to supply orders exactly, and now the 220 volt lamp seems to be in the field to stay. Reports from the plants are almost invariably encouraging, whether coming from manager or from patrons. Their common verdict that this is the best system extant must be accepted as proof positive of good, reliable service and of a good reputation at home, although it must be borne in mind that much of their praise comes from those who have had little or no experience with other modern systems and who also naturally stand up for home industries and for "our plant." Even the reports from engineers who have changed from 110 to 220 volts must be taken with some caution. For example, from one of the large English plants that has recently changed over comes the report that the new 220 volt lamps give better light with less watts than the 110 volt lamps displaced. But by test the 110 volt lamps were of very low efficiency and old at that. The new 220 volt lamp would doubtless give more light for a few hours than the old 110 volt lamps displaced, and the user remembers the favorable comparison at the time of change, and believes that it remains so, not being able by his unaided eye to discern the rapid decrease in light and efficiency of the 220 volt lamp.

The advantages of using higher voltages are well understood by engineers. Doubling the voltage allows a given district to be covered with one-quarter the weight of copper without increasing the percentage loss on the lines; or double the distance may be reached with the same weight of copper and the same percentage loss. It is commonly understood that 125 volt systems cannot economically serve districts more than about 1,000 feet distant. For larger districts the three-wire and alternating systems have had the field to themselves. But the low all-day efficiency of the alternating system, when used for scattered lighting, and the exclusive control claimed over the three-wire system have driven the independent manufacturers to the high-voltage lamp as the only practical means of competing for such business. The 220 volt lamp has been so successful for lighting villages and small cities that the alternating system seems to have given way and almost all of the new plants in such places now adopt the 220 volt direct current system, where a few years ago alternating systems had the field almost to themselves. The companies using the three-wire systems also find in the 220 volt lamp the possibility of extending their lines to outlying districts and of operating motors at 440 volts directly from the outside mains of the lighting service, instead of requiring special 500 volt generators and power circuits.

It is urged against the 220 volt lamp that it is of lower efficiency than the 110 volt lamp, so that the power plant must be larger to supply an equal amount of light. The larger item of interest on first cost of power plant and larger fuel account may more than offset the saving in cost of copper it calculated for the same percentage loss. The 220 volt lamps also cost more than the 110 volt, but this is unimportant, since the first cost of an incandescent lamp is only a small fraction of the value of the current used during its lifetime. Again, the average life of the low efficiency 220 volt lamp seems to be longer than that of the higher efficiency 110 volt lamp, so that the cost of renewals may even be in favor of the 220 volt lamp.

The economy of copper is even greater than indicated by the foregoing discussion. The allowable drop on a system of distribution is not determined in practice by Kelvin's much quoted and imperfectly understood law that the greatest net economy is secured when the value of the watt-hours annually lost on the lines just equals the interest and depreciation on the part of the line whose cost is directly proportional to the weight of conductor. The loss is usually determined in practice by the maximum variation of candle power that the customer will tolerate. Changes in the distribution of the load must be provided for and the system must be so planned as to avoid excessive variations of voltage. The high voltage on some lines that are lightly loaded when others have heavy loads gives fine light for a time, but the lamps age rapidly and give poor service. This, of course, is well understood by station managers, who wisely furnish low-efficiency lamps for such places. It is well known that the efficiency of a given lamp creases with the voltage. The candle power increases much more rapidly than the voltage. It also increases more and more rapidly. A given percentage change of voltage, therefore, affects the light much more when the lamp is working at high efficiency than when it is at a lower efficiency. Lamp makers advise the operation of lamps at high efficiency only when the regulation is close, and they advise low-efficiency lamps for use where the voltage fluctuates considerably. The 220 volt lamp cannot be made with as high efficiency combined with reasonable life as can the 110 volt lamp of equal candle power on account of the smaller diameter and greater length of the filament. When operating at high efficiency, the temperature of the filament is higher and the filament is therefore softer, less rigid and mechanically weaker. Since the 110 volt lamp is operated at as high a temperature as is practicable, it is seen that the 220 volt lamp, with its longer, smaller and much weaker filament, must continue to be less efficient. Whatever improvements may raise the practicable efficiency of the one will also improve the other, so that their relative efficiencies must remain about the same unless the 110 volt lamp meets the fate of the 52 volt and becomes a back number.

The necessarily lower efficiency of the higher voltage lamp is not an unmixed evil. For, since its efficiency is low, the allowable variation of voltage is greatly increased. Consequently, if two systems, one for 110 volts and one for 220, be laid out for equal percentage variation of voltage, the variation of the light from the 220 volt lamps will be hardly noticeable when that of the higher efficiency 110 volt lamp will be intolerable. From this it follows further that if the two systems be laid out for equal fluctuation of light, the 220 volt system will allow much greater percentage range of voltage and require correspondingly less investment in copper. This seems a reasonable result, even allowing for the counterbalancing greater drop due to the lower efficiency of the 220 volt lamps. The conclusion is therefore reached that the 220 volt system requires considerably less than one-fourth the weight of copper required by the 110 volt system for serving the same district with equal satisfaction to users. When it is considered that the cost of the feeders and mains often equals or exceeds the entire cost of the station equipment, it appears that the great saving in copper easily balances the increased cost of the larger generating plant and of the larger amount of fuel.

While the writer has not calculated in detail the exact results for any particular case, it is believed that the argument here given is in the right direction, and it is hoped that others in possession of more extended data may work out the problem in its commercial aspect.

Although 220 volt lamps have been on the American market for several years, there is a lack of published information regarding their performance. It is generally known that the lamps cost more and require more watts per candle than the 110 volt lamps, but exact figures are hard to find. In order to obtain accurate and reliable data concerning various 220 volt lamps on the market, new lamps were secured from the regular stock of several lighting plants in Minnesota, representing the regular output of three different manufacturers as furnished to regular customers. Samples were obtained directly from another manufacturer for test purposes. Lamps were ordered from a fifth factory which claimed extraordinary results, but they declined to furnish the lamps, ostensibly on the plea of being behind their orders, owing to an unusual rush of business.

Arrangements were made for a life and efficiency test of the various lamps. By the courtesy of the Minneapolis General Electric company, current at 220 volts was obtained from the outside mains of the Edison three-wire system. The city gas inspector allowed the use of his photometer room, which was connected with the three-wire street mains at a point about 2,000 feet from the station and where the voltage fluctuated as much as at any part of the system. The measurements were made by O. G. F. Markhus and W. A. Meyers, fourth year students in electrical engineering at the University of Minnesota. Carefully calibrated Weston and Whitney instruments were used for measuring current and voltage. A sensitive, frictionless recording voltmeter kept record of the fluctuations of voltage, which were found to remain close to the mean value. An Argand gas burner with Methven screen was used as the working standard, being calibrated daily by standard candles.

Before and after the life test two lamps of each make were tested for efficiency, by varying the voltage through a considerable range and measuring the candle power at various voltages. In each case the lamp was placed vertically and the candle power was taken in a direction at right angles to the plane of the base of the filament.

All of the lamps were operated continuously at the voltage marked upon their bases at the factory. For one lot of lamps marked 226 volts the line voltage was raised by three storage cells, which were renewed daily and kept well charged. Five

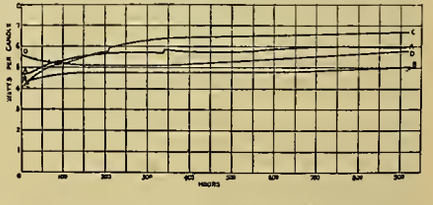


FIG. 2. 220 VOLT LAMPS.

lamps of each make were tested, three being placed vertically and two horizontally. Of the two horizontal lamps, one had the shank or stem in a horizontal plane, the other in a vertical plane. Readings of candle power and current at the marked voltage were taken each night for each lamp, the results being given in the curve shown in Fig. 1. The various makes of lamps are marked A, B, C and D. Although all the lamps were rated at 16 candle power and were operated at voltage marked on the base, it is seen that the initial candle power varies from 13.6 to 19.8, while lamp B rises to 21.1 candle power after 90 hours, gradually falling off to 14.4 candle power at the end of 920 hours, when the test ended. Four of the A lamps start at an average of 13.9 candle power, rising to 15.4 candles in 90 hours and then falling off to 13.8 candle power in 921 hours. One of the A lamps started at 12.4 candle power, dropped to 7.3 candle power in 90 hours and to 6.2 candle power in 921 hours. The general average for the A lamps begins at 13.6 candle power, rising to 13.8 in 90 hours and gradually falling to 11.9 in 921 hours.

There was also one bad lamp in lot C, which started at 15.7 candle power, but fell off to 9 candle power in 90 hours and to 6.2 in 921 hours. Four of the C lamps started at an average of 19.7 candle power, falling off to 15.4 candle power in 90 hours and to 13.2 candle power in 921 hours. The general average for the C lamps starts at 19 candle power, falling off to 14.2 candle power in 90 hours and to 11.4 candle power in 921 hours.

The general average of the D lamps, which were obtained directly from the maker, starts at 15.6 candle power, falling off to 13.5 candle power in 90 hours and to 13.4 candle power in 921 hours. These lamps seem to have been aged somewhat before leaving the factory.

The curves (Fig. 2) showing the variation of watts per candle with the life show equally interesting results. The good lamps of group A start at an average of 4.6 watts per candle, improving to 4.45 in 30 hours, increasing to 4.8 in 90 hours and to 4.94 in 921 hours. The poor A lamp starts at 4.6 watts per candle, increasing to 7.35 in 90 hours and to 9.1 watts per candle in 921 hours. The general average for group A starts at 4.6 watts per candle, increasing to 5.3 watts per candle in 90 hours and to 6 watts per candle in 921 hours.

Lamps of group B start at 4.3 watts per candle, increasing to 4.5 watts per candle in 90 hours and to 5 watts per candle in 921 hours.

The good lamps of group C start at 4 watts per candle, increasing to 4.6 watts per candle in 90

1. Read before the Northwestern Electrical association at La Crosse, Wis., June 21, 1897.

hours and to 5.5 watts per candle in 921 hours. The poor lamp starts at 4 watts per candle, increasing to 7 watts per candle in 90 hours and to 10.4 watts per candle in 921 hours.

Lamps of group D start at 5.5 watts per candle, improving to 5.3 watts per candle at 90 hours, to 5.1 watts per candle in 300 hours, and then increasing to 5.8 watts per candle in 921 hours.

At the end of 921 hours the life tests were stopped because of other work requiring the attention of the students, but since nearly all the curves of candle power and of watts per candle had become practically straight lines, it would probably be safe to exterpolate and prolong the curves almost indefinitely in the directions indicated.

The record of breakage is somewhat interesting. Twelve lamps of make marked D were obtained from the factory, six directly and six through an agent. Four broke in transit, two exploded as soon as connected into circuit. Of the two placed with globes horizontally, the one having the plane of the filament at base in the vertical position lasted throughout the life test, while with the one with plane of filament in the horizontal position the filament drooped in 159 hours so far as to touch the globe and crack it. The filament of the corresponding lamp of group C drooped and broke the globe in 215 hours. The corresponding lamp of group D broke in the same way in 315 hours. The anchor in the horizontal lamp of group A, having the plane of shank vertical, broke and allowed the filament to touch and break the globe after 345 hours. With these exceptions all the lamps were in fair condition at the end of 920 hours, when the test closed. The conclusions seem to be that if the lamp is hung vertically it will last 1,000 hours or more if it lasts 10 minutes. If the lamp must be placed horizontally, the shank of the filament should be vertical rather than horizontal. It is also suggested that the size of globes might be increased with advantage.

As a matter of general interest a new lamp of each group was subjected to a breaking test. Each lamp was placed in series with a water rheostat and then connected across a 500 volt circuit. The rheostat was adjusted so as to bring the lamp to its normal voltage. The voltage was then raised slowly and at a nearly uniform rate until the lamp broke, the current and voltage at instant of breaking being recorded by one observer while another noted the time taken to raise the voltage from normal to breaking point. The following table shows great variety both in the toughness of the filaments and also in the change of resistance:

Lamp.	Voltage.	Amperes.	Sec's.
A	316	1.05	31
B	366	.78	30
C	447	.85	40
D	378	1.10	31

The lamp tests here presented are offered not as an exhaustive research covering all suggested or possible problems connected with the performance of high-voltage incandescent lamps, but simply as a modest contribution to the literature of a subject upon which much has been written, but concerning which very little definite information is available. The tests were limited, both in the number of lamps tested and in the length of the run, but they were made under commercial conditions and it is hoped will be of some value to engineers.

In closing I will submit some reports recently obtained from a few of the 220 volt municipal plants in Minnesota, which were kindly placed at my disposal by W. I. Gray & Co. of Minneapolis.

COPY OF REPORTS RECEIVED FROM 220 VOLT PLANTS AT ADRIAN, WELLS, LAKE CITY AND WINDOM, MINNESOTA.

Adrian: The electric light plant consists of an 80 horse power high-speed engine made by the Ball Engine company and a 55 kilowatt dynamo made by the Siemens & Halske Electric company. The plant has operated two years with entire satisfaction. Arc lamps used, Manhattan; incandescent lamps, Edison. Average of incandescent lamp life, about 600 hours; number of arc lamps used for street lighting, 12; number of arc lamps used for inside lighting, none; number of incandescent lights used in stores, 480 16 candle power; number of incandescent lights used in residences, 110 16 candle power; cost of 16 candle power incandescent lights per month in stores, 45 cents; cost of 16 candle power incandescent lamps in residences per month, 45 cents for 10 o'clock circuit, 55 cents for 11 o'clock, 65 cents for 12 o'clock; the plant runs at this season of the year (January, 1897) six hours per day; meter rate to consumers, 8½ cents per 1,000 watts; income from the plant per month, $185; expenses of operation per month, $195; amount of (Youghiogheny) coal used last month, about 19 tons. The waterworks and electric lights are operated from the same plant at Adrian.

Wells: The electric light plant consists of an 80 horse power engine made by the Ball Engine company and a 50 kilowatt dynamo made by the General Electric company. The plant has operated two years with good satisfaction. Arc lamps used, Thompson '93 and Manhattan; incandescent lamps used, Edison; average life of incandescent lamps, 600 hours; number of arc lamps used for street lighting, 6; number of arc lamps used for inside lighting, 16; number and candle power of incandescents lights used for street lighting, 25; number of incandescent lamps used in stores and residences, 900 16 candle power; cost of 16 candle power lamp per month in stores, 50 cents for 10 o'clock, 65 cents for 12 o'clock; residence lights all on meters; meter rate to customers, 10 cents per 1,000 watt-hours; average load, 125 amperes; largest load, 196 amperes; income from plant per month, $300 average; expenses, $300; amount of Wilmington coal used (January, 1897), 45 tons.

Lake City, Minn.: The electric light plant at Lake City consists of a 125 horse power Ball and Wood engine, a 40 kilowatt, 220 volt dynamo made by the Commercial Electric company, and one 75 light Excelsior arc dynamo. The plant has operated for 1½ years with entire satisfaction. Incandescent lamps used, Edison; number of arc lamps on streets, 45; number of arc lamps for inside lighting, 11; number of incandescent lamps for inside lighting, stores and residences, 850; cost of 16 candle power lamp per month in stores and residences, 40 cents for 9:30 o'clock, 50 cents for 11:30 o'clock; largest load in amperes, 115; the plant runs at this season of the year (March, 1897) eight hours per day; meter rate to consumers, 10 cents per 1,000 watt-hours; income from plant per month, $225.

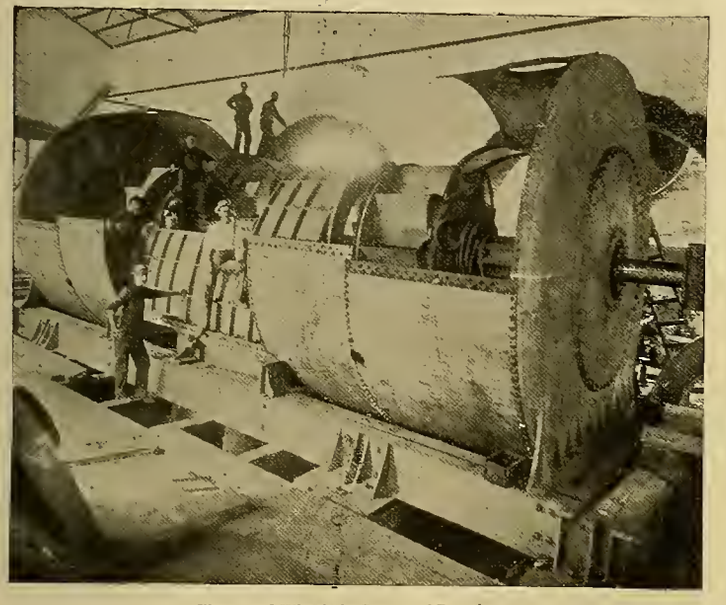
Windom, Minn.: The electric light plant at Windom, Minn., consists of an 80 horse power high-speed engine made by A. L. Ide & Son and a 60 kilowatt 220 volt dynamo made by the Western Electric company. The plant has operated one year with good satisfaction. Arc lamps used, Western Electric company; incandescent lamps, Edison; average life of incandescent lamps, 400 hours; number of arc lamps used for street lighting, 4; number of arc lamps used for inside lighting, 18 (Manhattan); number of incandescent lamps used for street lighting, 40; number of incandescent lamps used in stores and residences, 700; cost of 16 candle power incandescent lamps per month, four and over, 45 cents; average load in amperes, 150; largest load, 210 amperes; meter rate to customers, 10 cents per 1,000 watt-hours; income from plant per month, $225; expenses of operation per month, $165; amount of coal used (January, 1897), 38 tons.

These are all municipal plants owned and operated by the cities

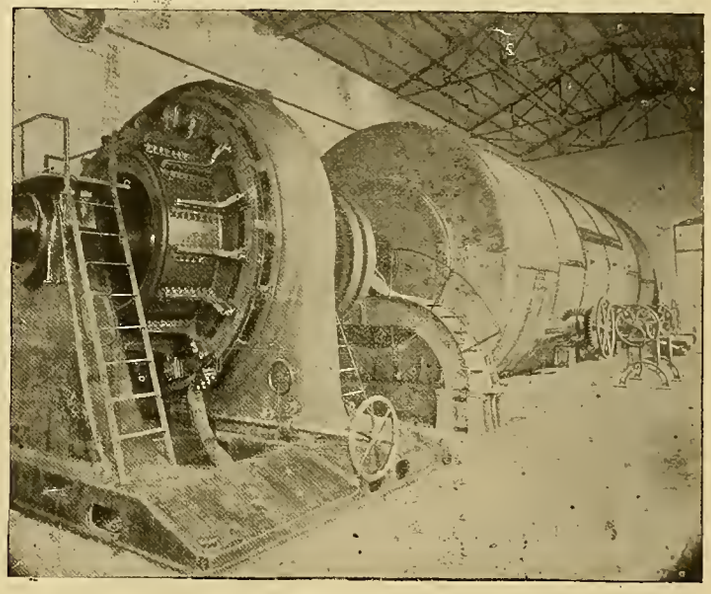
Power Plant at Great Falls, Mont.

An interesting installation that is attracting considerable attention at Great Falls, Mont., is employed in the works of the Boston and Montana Consolidated Copper and Silver Mining company. It includes a pair of horizontal turbines said to be the largest and most powerful, for the head of water under which they operate, that have ever been built. These turbines are of the latest design of the new American pattern, 57 inches in diameter, and under a head of 50 feet will develop 3,945.6 horse power. The turbines are placed on a cast-iron draft chest and discharge centrally through a draft tube 10 feet in diameter, and are encased in an iron flume 14 feet 4 inches in diameter, 32 feet 6 inches long, made of half-inch tank steel, with cast-iron heads, and the flume is mounted on two pairs of double I-beams 20 inches deep, 38 feet long. The shaft in the wheels is 10 inches in diameter, 42 feet 2 inches long, made in two sections, and its weight is over five tons. The clamp coupling which connects these two sections of shafting in the center of the draft chest weighs considerably more than one ton. There are stands, weighing 8,000 pounds each, outside of the flume at each end, which carry the journal boxes for this shaft. The two turbines, with their complete outfits, weigh approximately, 250,000 pounds.

They operate two Westinghouse electric generators, one direct-coupled to each end of the shaft, which runs from 144 to 160 revolutions per minute. The current is used for electrolytic refining. The varying speed at which the machines operate increases or diminishes the current as conditions may require. In addition to the large Westinghouse machines shown in the cut, power is furnished for an arc light dynamo and the two 50 horse power exciters for the large generators, the power being transmitted from the wheel shaft to the dynamo by means of a 20 inch double leather belt.



Flume and Wheels in Course of Erection.



Interior of Power House.

POWER PLANT AT GREAT FALLS, MONT.

The photographs from which the illustrations were made were taken in the power house at Great Falls, one of which represents the erecting crew at work on the mammoth flume, and the other shows the turbine outfit completed, connected by means of flexible couplings to the Westinghouse generators.

Under test, conducted by the Holyoke Water Power company before shipping, these wheels, both the right hand and left hand turbine, showed an average efficiency from three-quarter to whole gate inclusive of 81¼ per cent., which is particularly pleasing, in view of the fact that these turbines were the first ones ever made of that diameter by the Dayon Globe Iron Works company of Dayton, Ohio, which installed the plant. These wheels were sold on a guarantee that they would show an average efficiency of 80 per cent. from three-quarter to whole gate and would develop 2,800 horse power under 40 feet head, and they exceeded the guarantee both in horse power and efficiency.

It is worthy of mention that the buckets were made very thick, as the turbines were required to stand the great strain due to 50 feet head. Had they been made of the ordinary thickness, it is estimated that the percentage of useful effect would have been increased to 83½ to 84 per cent. This was the judgment of a number of engineers who made an examinaton of the turbines. Another factor to be considered is that the turbines were tested with the ordinary cylinder below the wheel, whereas flaring draft tubes or diffusers would have increased the percentage.

The Sturgis Electric Light and Railway company has been granted a right of way on the Fort Meade reservation in South Dakota for an electric motor line.

Effect of Heat on Insulating Materials.[1]

By Putnam A. Bates and Walter C. Barnes.

A paper on this subject was presented before the American Institute of Electrical Engineers on May 20, 1896, by Messrs. Sever, Monell and Perry. In the discussion which followed, the results were questioned by several members, and C. F. Scott cited some investigations of Mr. Skinner, who obtained curves which differed very considerably from those shown in the paper. For the present investigations the ordinary "red fiber" insulating material, having the general appearance of thick red paper, has been selected. Its thickness is about .009 inch.

The apparatus consists of two distinct parts, the device for heating and that for testing the insulation resistance. The heating apparatus consists of a single electric heater, having a radiating surface of 47 square inches. This is nothing more than six resistance coils tightly packed with asbestos in a short sheet-iron cylinder, whose lower end is open. The terminals come from the ends of this set of resistance coils through the bottom of the heater, and are then connected through a suitable switch to a 110 volt circuit. This heater is supported on three porcelain insulators, which rest on a slab of slate 1½ inches thick and one foot square. The heater takes exactly four amperes of current when all other resistance is cut out of the circuit.

Around the heater is placed an earthenware cylinder one foot high and nine inches in diameter. This provides an excellent method of keeping the heat in, and together with the electric heater secures perfect regulation of temperature. The terminals of this heating circuit are brought directly down and out from the heater through the base slab of slate to the terminals of a 110 volt lighting circuit and are thus kept entirely separate from any other part of the testing apparatus.

Resting on an asbestos collar and at a height of about two inches above the heater, in the earthenware cylinder, is placed a circular iron plate one-eighth inch thick, which is one terminal of the testing circuit itself and is connected to one binding post of a Thomson high-resistance galvanometer; a standard megohm being placed in series between the two.

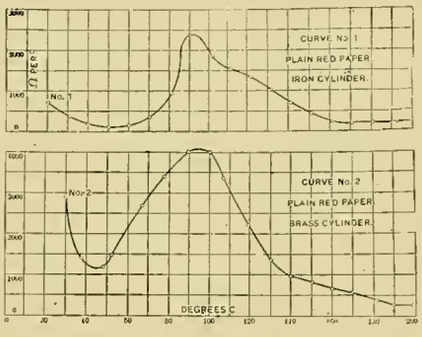


FIG. 1. EFFECT OF HEAT ON INSULATING MATERIALS.

The insulating material to be tested is wrapped on an iron cylinder three inches in length and having an external diameter of .875 inch, the insulation not quite reaching to the ends of the cylinder. The insulation is then wound with No. 26 B & S bare copper wire. This winding makes the other terminal of the testing circuit, and is connected to the other post of the galvanometer. The iron cylinder, upon which the insulation is placed, is then placed upright on the above mentioned iron plate. Thus it will be seen that the insulating material now separates the copper wire winding, as one terminal, from the iron cylinder, which is now in contact with the iron plate, as the other terminal. The leading-in connections to these terminals pass through small holes bored in the earthenware cylinder. Glass insulators are used in these holes in order to prevent any current from creeping across from one wire to the other over the surface of the earthenware. Heavy covers of asbestos board are placed over the top of the earthenware cylinder, and this again is entirely covered with a large glass globe.

The potential used in this circuit is 500 volts. A suitable shunt, consisting of one or two turns of bare copper wire wound on each end of the sample of insulation, so situated that they would intercept and shunt past the galvanometer any current tending to leak along the surface of the insulation from the iron cylinder to the winding, that is, from one terminal to the other, is used in order that a deflection of the galvanometer needle will be produced only when a current actually passes through the insulating material under test.

In making the apparatus we have been very particular to eliminate all metals, with the exception of iron and copper, thus avoiding any possibility of the volatilization of zinc, which was one of the points raised in regard to the previous tests.

This apparatus when complete works admirably, absolutely no difficulty being experienced with either the heating or the testing circuit.

The questions that we have attempted to answer by this investigation are four in number, viz.:

First—Does the presence of brass or other metals from which zinc may become volatilized, in the apparatus in which the test is conducted, affect the insulating material or its behavior?

Second—Why should one experimenter obtain an insulation resistance curve for fiber, whose minimum point is at about the same temperature as the maximum point of an insulation curve obtained from similar material by another experimenter?

Third—What effect on fiber insulating material is produced when it is subjected to conditions similar to those likely to occur in dynamo-electric machinery?

Fourth—What is the action or actions that take place when fiber insulating material is repeatedly heated from 20 degrees C. to 200 degrees C.?

Question No. 1 has been approached in the following manner: The resistance of the insulating material at the temperature of the air, or 20 degrees C., being determined, the temperature is gradually raised until 200 degrees is reached, when the test is discontinued. The time taken for this rise was exactly 2½ hours. Resistance measurements are made at frequent intervals, and from these curve No. 1 is plotted, the area of insulation tested being 5.5 square inches thickness = .0095 inch.

The position and shape of this curve agree very closely with the results obtained by Messrs. Monell and Perry, who in their experiment used a brass cylinder, but a confirmatory test with a brass cylinder was also made in our apparatus. This experiment was deferred until the completion of all other experiments.

Curve No. 2 thus obtained from a like sample of insulating material, thickness .0095 inch, area tested = 4.6 square inches, showed that the presence of brass in the apparatus does not affect the shape or position of the curve.

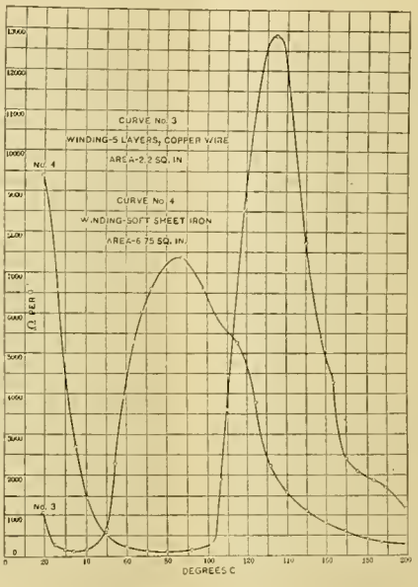


FIG. 2. EFFECT OF HEAT ON INSULATING MATERIALS.

In taking up question No. 2, it is intended to prove by comparative tests that the position of the maxima and minima points of the resistance curves depend upon the opportunity of escape given to the moisture originally contained in the specimen.

Curve No. 3 shows the results from a test on a sample of plain red fiber, thickness .009 inch, the area of insulation under test being 2.2 square inches. In this case five layers of No. 26 B. & S. bare copper wire were wound closely upon the fiber, the length of winding being only .8 inch.

Curve No. 4 has been obtained from a test on a specimen cut from same sample wrapped with a sheet of thin malleable iron held firmly in place by a number of layers of tightly wound copper wire, thus approaching the conditions under which the experiments cited by Mr. Scott were made. The area covered by this iron wrapping is 6.75 square inches. This test consisted, as before, in gradually raising the temperature from that of the air to 200° C., the resistance being measured at frequent intervals. The curve obtained under the conditions named is almost identical with that published by Mr. Scott.

It is clear from these two experiments that the position of the curve may be shifted at pleasure by simply varying the opportunity for the escape of the moisture originally contained in the insulating material. That is to say, if we wind our specimen with wire and only cover a small area, we find that the moisture has a much better chance of escape than if completely covered with an iron wrapping extending over a large area, and that the curve will actually take a position depending upon the rapidity of escape of the moisture. In the case of the wire-wound specimen the moisture escaped not only through the interstices between the wires, but also, and to a much greater degree, from the exposed ends which it reaches through the pores of the material; while with the iron-wrapped specimen the only chance of escape is from the exposed ends. Therefore, the greater the area covered, the longer will be the path traversed by the moisture and consequently a longer time or higher temperature will be required.

Question No. 3. A new specimen of plain red fiber .009 inch thick was wound with four layers of No. 26 B. & S. bare copper wire, the area covered being four square inches, and then subjected to the variations in temperature and exposure to moisture which are most likely to take place in dynamo-electric machinery.

Insulating material when used in this way is subjected to repeated heating and cooling, being kept at a moderately high temperature for varying lengths of time, also being exposed more or less to the moisture in the air. Therefore, the following eight tests have been made under conditions approximating the above and upon the above described specimen.

In all of these tests the temperature is gradually raised from that of the air, 20° C., to 80° C., at which temperature it is kept constant for 3½ hours. The time taken to raise the temperature this amount is about 45 minutes.

Curve No. 5 has been obtained from the first heating. The specimen was then allowed to stand unexposed to moisture for 16 hours, at the end of which time a like test is made, giving curve No. 6. After a lapse of 24 hours, during which time the specimen was exposed to the atmosphere, which was very damp, the temperature is again gradually raised and kept constant as before, curve No. 7 resulting.

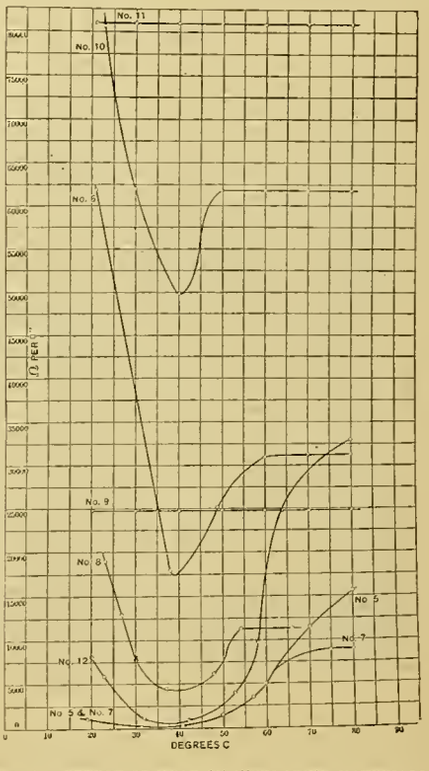


FIG. 3. EFFECT OF HEAT ON INSULATING MATERIALS.

It will be seen by examination of these curves that the specimen after exposure to moisture returns to its original condition. The method of exposing the specimen to moisture is to remove the glass globe from the apparatus and the asbestos covers from the top of the earthenware cylinder, the specimen itself being undisturbed. Three days (72 hours) having elapsed, the specimen being undisturbed and unexposed to the atmosphere, is subjected to further test, giving curve No. 8.

Great care is now taken to protect the specimen from all moisture for 16 hours; at the end of which time, upon again testing, curve No. 9 is obtained. The test consisted, as before, in raising the temperature to 80° C., where it was kept constant for 3½ hours.

All covering is now removed and the specimen allowed to cool to 23.3° C., the time occupied being 3¾ hours. Curve No. 10 is then obtained upon reheating.

Again great care is taken to protect the specimen from disturbance and all moisture for 19 hours. On being again subjected to test, curve No. 11 results.

Now the specimen is allowed to stand for exactly five days freely exposed to the moisture of the atmosphere, it being situated in a room near a window which is left open a considerable portion of the time, thus subjecting the specimen to conditions of atmosphere similar to those occurring in a station or factory.

The weather during the five days was unusually damp. A number of severe rainstorms occurred, thus giving the specimen an extremely good opportunity to absorb moisture. At the end of this time

1. Read at the fourteenth general meeting of the American Institute of Electrical Engineers, Eliot, Me., July 26, 1897.

a test was made, from which curve No. 12 was derived.

The object of this test is to see if, after exposure to moisture, the material will return to its original condition. By a glance at the curve thus obtained it will be seen that this actually takes place.

Let us now compare the eight curves. Curve 5 represents the original resistance variation of the material. Curve 6 shows the increased initial resistance on cooling, the specimen having been protected from moisture in the meantime. Curve 7 shows the return to the original condition on absorption of moisture. Curve 8 the higher value of the resistance curve when the specimen has been kept at 80° C. for 3½ hours and then allowed to cool, but not exposed to moisture. Curve 9 shows that the heating up to 80° C. has practically no effect on the resistance after the moisture has been driven out and not allowed to return. Curve 10 shows the condition into which the specimen was thrown when cooled while exposed to the atmosphere. Curve 11 indicates that the moisture had again been practically been expelled, and therefore the heat produced no change in the resistance. Curve 12 shows that the specimen, having been freely exposed to moisture, has returned to almost its original condition. In all these tests the resistance remained constant during the entire time that the temperature was kept constant. On examination, the specimen was found to be practically unchanged in appearance, mechanical strength or other qualities. One might, therefore, conclude, on inspection of the various curves in connection with these experiments, that the action which takes

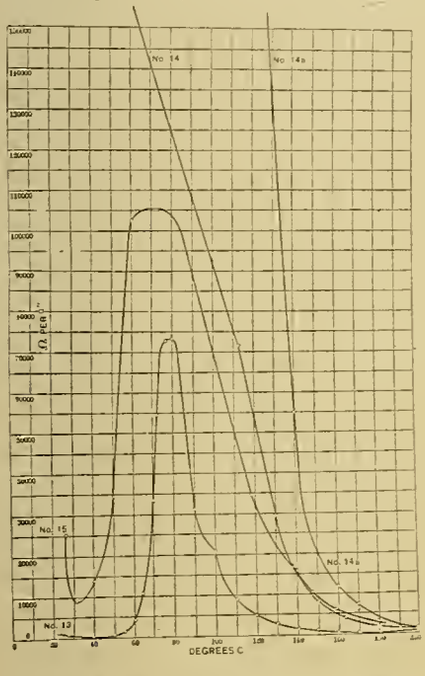


FIG. 4. EFFECT OF HEAT ON INSULATING MATERIALS.

place in a fiber insulating material when heated up to about 80° C. merely depends upon the amount of moisture contained in the material at the time at which each measurement is made.

Question No. 4 may be answered by reference to the curves obtained from the three tests on one piece of insulating material wound with four layers of No. 26 B. & S. bare copper wire. Area of insulation under test was 4.125 square inches, and the thickness was .009 inch.

Curve 13 is the resistance curve for the first heating from 20° C. to 200° C.

The descending portion of the curve between 23° C. and 40° C. is probably due to the coalescing of the moisture within the material; that portion between 40° C. and 80° C. shows the rise in resistance due to the expulsion of the moisture and the remainder the negative resistance coefficient which insulators usually possess.

This test being completed, the specimen was allowed to stand undisturbed and protected from moisture for 24 hours. Upon reheating, curve 14 was then obtained. This shows the rapid drop from the enormous resistance acquired by the material on cooling from the previous test

While the specimen was cooling from the heat applied in test 14, frequent measurements were made, resulting in curve 14a, which shows the rise to a still higher resistance than before. At 100° C. the resistance was too great to be measured by the apparatus at hand.

Now the specimen was allowed to stand undisturbed for 36 hours, during which time the air in the apparatus was kept moist. Curve 15 was then obtained on repetition of the test, showing that the material when repeatedly heated to 200° C. still retains its property of absorbing moisture, and the effect upon its insulation resistance is not as great as would be expected. But it should be noted that this high temperature of 200° C. greatly injures the mechanical strength of the insulating material.

From the foregoing we may derive the following general conclusions:

a. The presence of brass in the apparatus does not affect the shape and position of the curve.

b. The difference in the curves depends solely upon the amount of moisture contained in the material and its opportunity to escape.

c. Every time the specimen cools the resistance increases to a value much above any resistance that it possessed before, provided it is kept from absorbing moisture.

It is impossible to determine the limit of this action with the present apparatus. But all the curves, particularly Nos. 5 to 13, clearly show this stepping up effect, which is practically the same as the well-known result obtained by baking insulating materials.

New Form of Induction Coil.[1]

By Elihu Thomson.

The induction coil presently to be described, it is believed, constitutes a new type employing the principle of a "substitute primary" or "secondary primary," which principle has been applied by me in a variety of ways.

The prime object of this coil is to permit the direct connection to circuits of considerable potential for obtaining energy for the production of high potential discharges, like those of a Ruhmkorff coil for working Röntgen ray vacuum tubes, and for such like purposes. The object, also, was to avoid the employment of banks of lamps or storage batteries and to limit the energy consumed to only that amount required to work the coil itself. Furthermore, no larger condensers than those ordinarily used with an induction coil of equal capacity are needed, and no airblast, while the coil as a whole is still available as an ordinary Ruhmkorff without change in its structure or connections.

To illustrate the principle, reference is made to Fig. 1, where p n represent connections to mains at, say, 110 volts difference of potential; I I is an iron wire core around which are wound two coils, one over the other, either of which may, of course, be the primary. The inner coil P in the figure is made the primary, and is wound with many turns of comparatively fine wire. For 110 volts it may have some thousands of turns and be wound with a wire safe for .5 to .75 ampere. The outside wire S may be coarse or fine. In the figure it is quite coarse and of relatively few turns, since it is assumed to give low potential and large current. The coil S is so proportioned as to be practically almost short-circuited at intervals by its load at B, which is three cells of storage battery in series, for example. The object is assumed to be that the batteries are charged by transference of energy from coil P to S at low potential in S. The coil S should have ample copper so as to lower its internal resistance as much as possible; the resistance of the cells B should be low, and the average voltage of discharge of S much superior to the counter electromotive force of B. Two synchronously revolving break-pieces, E, F, which may, in fact, be combined into one are used; E is for governing the intervals of passage of current in coil P and connection of condenser C across the break or interruption periodically made betwen one terminal of P by a brush G and a metallic segment on E occupying a considerable arc on its periphery. Brush H connects to main n. Back of the main segment on E is a small condenser segment in continuous connection with one side or foil of the condenser, and the other side is connected to the other terminal of P, or that leading direct from line p. The contact maker and breaker F has a segment which is in continuous connection with one terminal of battery B to be charged, and which touches a stationary brush J, at or about the time of the break, between brush G on the main segment of E. The battery B may have terminals by which it may furnish current while being charged.

Now let the break-wheels E and F be given rapid revolution, say, 10, 20 or 30 per second. The contact of brushes G and H with the main segment of E passes current for a certain considerable fraction of the revolution, at full line potential of 110 volts, through primary P. The current rises gradually during this period, and may at the end attain a value of one ampere, more or less. With slow revolution it would be limited by the resistance of P chiefly, but at rapid rates the time constant of P, acting as a self-induction, determines the ultimate value of current before breaking. Upon the break of brush G with the main segment, it touches the condenser segment, which is thereby put across the break, but the circuit of S is also closed by contact of segment on F with brush J. The condenser receives only a small charge on account of the circuit of S having been closed. In fact, the break at G with main segment of E would be nearly sparkless without the condenser C, but what slight self-induction is not wiped out by the mutual induction of the currents in S and P is very easily taken care of.

The magnetizing of the core I I or absorption of energy is by P, while delivery of energy is by S acting as if nearly on a closed circuit. This condition, however, does not involve much waste of energy if the ohmic resistance of the circuit of S be low enough. Here, then, is a transfer of energy from one circuit to another while the currents are direct currents in each circuit. To insure this being the case in S, the time of contact of segment on F with brush J must be selected so as not to permit any reversal, i. e., the break of said segment with K must be timed to be made on the cessation of the first impulse or discharge from S. To do this an ammeter, responding to direct currents only, placed in the battery circuit, or in the leads from S, will indicate a maximum direct current when the segment F is of proper extent, and less under other conditions.

With the principles of the above apparatus in mind, it is easy to understand the action of my new form of induction coil, which may be described briefly as follows: The iron core I, Fig. 2, of the induction coil is wound with the ordinary coarse

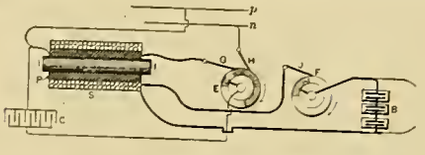


FIG. 1. NEW FORM OF INDUCTION COIL.

primary coil, and terminals provided therefor. Then a coil of intermediate gauge, between the inner primary and the outer secondary, is wound. It is to be capable of being connected across a circuit of 110 volts, as with coil P, Fig. 1. This coil is the true primary or energy-supplying coil, but for convenience and saving of wire I prefer to connect it in as the under portion of the real secondary circuit. It thus becomes useful as a part of the secondary itself, and, having several thousand turns, adds a considerable fraction to the total potential of the secondary. The secondary is, as usual, of quite fine wire of many thousands of turns, well insulated throughout.

In Fig. 2 the coarse coil is marked S P and the intermediate coil P S, while that outside is marked S. The functions of the coils S P and P S are to act as secondaries and primaries alternately. This is, in fact, an essential function of S P, but is only incidental to coil P S, having been connected into the secondary circuit S, whose terminals are at t t. The break-wheels E F are like those of Fig. 1, except that in F there is a much shorter main segment and a condenser segment following, as in E. There is no battery in the circuit of S P, but is put on dead short-circuit at intervals, just at the time P S is broken. Coil P S receives current from line at p n at 110 to 200 volts or more. On the break of this circuit at brush G the ampere-turns, so to speak, are shifted suddenly into circuit of S P, closed on itself by J F. The consequence is that even at slow breaks no spark occurs at the rupture of G E. As soon as the current has been fully established in S P on short-circuit, and after brush Q has got entirely away from all metallic connections on E, the main segment of F breaks the circuit of S P, which is conveying a very heavy current at low potential. The condenser C is put instantly across the break, and the spark flies between terminals t t. In this way a coil of the size of a six-inch Ruhmkorff gives a torrent of six-inch sparks with an average current from a 110 volt line of about one-half an ampere. A simple motor or clockwork may be used to drive the break-wheels E F, which are made of fair diameter to insure accuracy in operation. The best results are only to be obtained when the proportioning of the parts is carefully done, and with a knowledge of the result to be obtained.

The discharges are indistinguishable from those of a similar Ruhmkorff. In fact, the coil described might be used with the same condenser C as an ordinary Ruhmkorff coil energized by batteries. In this case the terminals of the coil section P S are disconnected, brush J lifted and battery inserted between brush G and terminal of S P, which goes

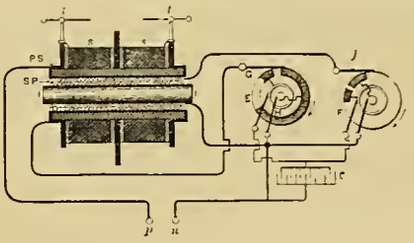


FIG. 2. NEW FORM OF INDUCTION COIL.

to J in Fig. 2. The break-wheel, E or F, when run with low potentials, may be immersed in water in the usual way to facilitate sharp breaks, but the apparatus has been very successfully run, at full output, dry, or a little heavy oil on the break suffices. Also the flux of current in S P may be made by a magnet to break its own circuit under water when the current has risen to a predetermined amount. In other words, it may be provided with the usual automatic break, damped or adjusted not to get into tremulous vibration. It will be seen from the above description that a new way of energizing an induction coil or other transforming apparatus has been embodied and that it consists in the rapid substitution of secondary and primary functions in the coil S P.

1. Read before the American Institute of Electrical Engineers, Eliot, Me., July 26, 1897.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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With the Niagara Falls convention number of the Western Electrician, dated June 12, 1897, this journal made a new record for itself both in circulation and advertising. Of this 100-page number 20,000 copies[1] were printed and circulated and the amount of full paid advertising matter carried was 8,643 square inches.

Beginning with the convention number of March 3, 1894, the record shows constant gains each year until in the present case the number of square inches of full paid advertising matter is more than double that of the 1894 number. The figures showing this unprecedented gain are given in the accompanying table:

Issue	Number of Advertising Pages.	Whole Number of Pages.	Square Inches of Paid Advertising Matter.
March 3, 1894....	40	56	4,145
February 23, 1895.	52	68	5,593
May 9, 1896.....	72	88	7,576
June 12, 1897.....	80	100	8,643

This constantly increasing patronage speaks eloquently of the influence and merit of this journal and of the confidence and respect which it commands throughout the country. It is pleasing recognition of the efforts that have been made in the interest of the entire fraternity.

On another page of this issue is presented a highly interesting interview with Lord Kelvin, upon the development of Niagara and power transmission, principally. It will be seen that the eminent visitor is conservative in his estimate of the practicability of transmitting power long distances by electricity.

Advices from London indicate that the trouble betwen the Postal Telegraph Clerks' association and the government has been terminated, for the present, at least, as the members of the organization have determined not to strike, but to continue their agitation for redress of their grievances. The committee which negotiated with the postmaster-general declared that it could not recommend the members of the association to accept the decision of the postmaster-general as final. It added that it was unable to longer consider the possibility of a compromise. The telegraph clerks, who in England are employes of the government, have a number of grievances. The principal complaints were directed against the smallness of their pay, being compelled to work overtime without extra compensation, and the examination which they are obliged to undergo when seeking admission to the senior grades. The postmaster-general declined to concede the request that the maximum salary be increased from $800 to $950 per year, but agreed to create 40 additional superintendents in order to relieve the pressure of work, to abolish the technical examinations of candidates for the senior grade, and to grant a double increment after five years' service to clerks who are under 21 years of age. The service has suffered greatly during the adjustment of these difficulties, and public attention in this country and in England has been directed to the fact that governmental control of the telegraph has not prevented labor troubles, although that was one of the blessings to be gained.

American scientists can learn a lesson in loyalty at least from their English contemporaries. The British Association for the Advancement of Science, which is in session this week at Toronto, is one of the great institutions of the empire, and it is zealously supported by workers in every department of pure and applied science. Unlike the American association, the English organization commands the best efforts of the most eminent scientists of the nation. Moreover, its meetings are attended, and the members consider it an honor to be permitted to contribute to the discussions. They work for its prosperity, even where their personal comfort and convenience suffer. Lord Kelvin, for instance, has not missed a meeting in 40 years. He has twice crossed the ocean for the purpose of participating in the meetings on this side of the Atlantic, the first time being in 1884, when Montreal was the scene of the gathering. There are many other prominent Englishmen in the British Association. Sir John Evans, for instance, who presided at the Toronto gathering, was one of the most successful business men of Great Britain for years. When he retired from the paper-making industry he devoted his attention to geology, antiquities and old coins, and he has earned considerable distinction by his researches. Sir William Crookes is another distinguished worker and Sir John Lubbock, the naturalist, is said to be more devoted to his scientific work than he was to finance when his ability in that field brought him into prominence. With such men devoted to science, is it to be wondered that scientific study in England is popular with all classes? Then, too, the honors that are bestowed on those who are successful in scientific work are a great inducement to a title-loving race.

The same character or degree of care to avoid collision must be exercised by those operating an electric car along a public highway, in approaching and going over a steam railroad crossing, as is required of one driving or operating an ordinary vehicle. They must look and listen for the approaching train. If such care be not exercised, the electric railway company will be liable to the steam railroad company for injuries arising therefrom by reason of collision, unless the negligence of the servants of the railroad company contributed to the accident. This is the substance of a decision by the Supreme Court of New Jersey in the case of the New York and Greenwood Lake Railroad company against the New Jersey Electric Railway company. The steam railroad company, the court maintains, has the right of way over the crossing, and may run at a high rate of speed. Ordinarily it exercises all the care required when the whistle of the locomotive is sounded or its bell rung at the distance from the crossing prescribed by the statute. But this it is bound to do, and, if the neglect to comply with this provision of the statute contribute to the collision and injury, the railroad company will be prevented from a recovery for injuries sustained in the collision. The fact that the electric and steam railroad companies have an agreement between them providing for a derailing switch on the tracks of the electric railway, as a precaution against collision at the crossing, and providing in addition that before an electric car shall be permitted to pass over the crossing the conductor of the electric car shall look in both directions, and listen for the approach of the railroad train, the court holds, will not excuse the railroad company from giving the statutory warning signals. Nor will the latter company be entitled to recover from the former damages for a collision, notwithstanding any negligence on the part of the conductor of the electric car, if its neglect to give the required signal appears to have contributed to the accident.

Indianapolis has determined to appeal from the decision of Judge Showalter in the three-cent fare case to the United States Circuit Court of Appeals, the question being the right of the city and state to fix the charges of corporations and to regulate the service. The final settlement of this case will affect many corporations besides the street railway company. The gas company, for instance, is at present fighting an ordinance passed by the City Council of Indianapolis reducing the price of gas furnished by the company to 75 cents per thousand feet, the former price being $1.25. In this case, as in that of the street railway company, much will depend upon the terms of the franchise and the conditions under which the company is now operating. The street railway company claimed, and the court held, that the act reducing fares was invalid because, first, it was special legislation, as it related only to one city, that of Indianapolis, described as having over 100,000 population by the census of 1890. No other city in Indiana had that population. Second, the provision for the reduction of fares violated the charter of the corporation, which was a public contract. The ruling of the Supreme Court of the state is precisely contrary to that of the United States Circuit Court, and it was accordingly determined to carry the case to the highest tribunal, the Supreme Court of the United States, as speedily as possible.

In the meantime the war on corporations is being waged with unabated vigor in Indianapolis. The State Board of Tax Commissioners has increased the assessment of the street railway property from $1,900,000 to the sum of $3,000,000. The assessment of the gas company was raised from $1,000,000 to $1,500,000.

An early judicial settlement of the question of the power of local authorities to reduce charges for the service which corporations render and to impose taxation may be had in the result of the quarrel between the Indianapolis corporations and the public, as nearly every question on the subject has been raised and must be determined in the courts. Street railway and lighting corporations in other states will be affected by the decision.

1. State of Illinois, County of Cook—ss:
Thomas Jansen, being duly sworn, deposes and says that he is a resident of the city of Chicago, in the county of Cook and state of Illinois, and that he is the foreman of the printing department of the Electrician Publishing company, the publishers of the Western Electrician; that he was present at and superintended the printing of No. 24 of Vol. 20 of the Western Electrician, issued on June 12, 1897, and that there were printed by actual count 20,000 complete copies of said Western Electrician of the volume and number above specified. And further this affiant sayeth not.

THOMAS JANSEN.

Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

Electric Metering from the Station Standpoint.[1]

By Caryl D. Haskins.

The general adoption of the electric meter is in itself an endorsement of the precise methods which characterize engineering practice. It is, indeed, a well established fact to-day, well borne out by data from widely separated portions of the country, that the average electric lighting station can do one-third more business with the same station capacity on a meter basis, than it could upon a contract basis, under what were nominally equivalent contract rates, netting at the same time the same revenue per light as formerly. In other words, it is apparently well established that 33⅓ per cent. represents the average wastefulness of average human nature in connection with the use of light.

In many central stations to-day, I find that, whilst managers are almost universal in favor of an exclusively meter basis, a large proportion are still in ignorance as to what qualities they should seek and what they should avoid in selecting a meter.

In response to an inquiry as to what merits in a meter are necessary to success, a common reply is, accuracy, durability, registration in a simple unit easily comprehended by the customer, and ability to withstand tampering. These points are probably of importance in about the sequence in which they are commonly stated; but they are too sweeping, too entirely generic and too slightly specific to be in any high degree helpful.

Let us, for example, consider the broad question of accuracy. A meter, which will be accurate under commercial condition from quarter load to full load within 1-10 of one per cent., or a meter which will start on one per cent. of its rated capacity, are neither of them necessarily either the most accurate or the best for general commercial use. This latter point is one which is frequently raised. The fact that a meter will start on one per cent. of its rated capacity is in reality no sure criterion of the accuracy of that meter, even on light loads. It is not necessarily even good evidence; yet I find that in very many cases this is almost the only test applied to meters at the time of purchase. The percentage of accuracy at light loads is very important, more important, I believe, than is commonly appreciated; but I am perfectly safe in saying, that a meter which will run within five per cent. of zero error on five per cent. of its rated capacity may readily be a much better meter, even though it will not run at all on one per cent. of its rated capacity, than one which will run on one per cent. of its rated capacity but in regard to which no evidence is at hand as to its percentage of accuracy at reasonably low loads.

Ability to start on very light loads is certainly an indication of merit and is important, but it is not nearly as important a point to determine as is the lowest load at which a meter begins to register with fair accuracy. I have inspected a very large number of meters which would start on phenomenally low loads and which would yet fail to give anything like approximate accuracy at reasonably low loads.

In considering the question of accuracy, therefore, the first two steps should be to determine the accuracy of the meter by actual measurements at full and medium load; and also at a reasonably low load; say, for example, five per cent. of the meter's rating.

That low load accuracy is really of vital importance is well shown by the fact, that with the average 24 hour station, in the neighborhood of 15 per cent. of the total station output goes to feed one and two lamp loads. Yet in the face of this I have seen large installations of meters reported as entirely satisfactory, tested with frequency and care under admirable systems, but only at full or medium loads, and yet failing to account for more than 50 per cent. of the one and two lamp loads, or in other words, losing to the illuminating company an average of probably 7½ per cent. of the revenue which their measured station output should give them, after deducting for legitimate losses.

Granting that, having determined the actual percentage of accuracy obtainable at light, medium and full loads, a very important and in fact probably the most important evidence as to accuracy has been obtained, there still remains much information of vital importance which should be sought and which should materially influence a decision.

One point which is very commonly neglected, but which is, nevertheless, quite essential, is the ability of a meter to give accurate results for brief periods on overloads. This is a point at which many meters fail, and it is also a point which, odd as it may seem, is intimately related to light load accuracy. It may be laid down as a rule, that in station operation the smallest meter which will do the work should always be used. Otherwise, however good the meter on light loads, much of the light load revenue must be lost in the effort to take care of occasional heavy loads. Extremely heavy loads are generally of brief duration, and on these loads a meter should operate with accuracy and also without injury to itself. This, therefore, should be an early point of investigation in selecting a meter.

On alternating circuits, inductive loads are becoming commoner every day. The wider use of fan motors and other alternating power devices, the rapidly growing popularity of alternating circuit arc lamps, and the commoner use of inductive dimmers, all render it essential that a meter should be accurate irrespective of the power factor. The company which insists upon charging its patrons for power delivered to fan motors on a basis of volt-amperes, is obviously rendering itself unpopular, greatly limiting its business and giving its competitor or competitors, the best of opportunity for intruding; yet many such companies exist to-day, and they exist not because they are following a wise policy in their own estimation, but because they are ignorant of what they should look for in the meter which they are using.

Again, there are few electric light stations to-day of any considerable size and age which are not operating some smooth core and some tooth core alternating armatures. It is, therefore, important that the meters in service at such stations should be equally accurate on any shape of wave; yet many meters fail in this particular; and seldom, if ever, is the point made a subject for investigation in selecting measuring apparatus.

This same consideration holds good in connection with frequency, and this is a point which it is difficult to overcome in most metering devices; but it is one which should be earnestly sought and which is of importance both to the station and to the consumer.

Even after this long list of points which must be investigated as contributing to the broad question of accuracy, there are others which also merit consideration, but to a less degree. Such for example, as barometric conditions (more especially altitude), temperature and humidity. These all have direct bearing upon the question and all enter into the everyday conditions of central station practice.

Summing up the question of accuracy, we may say, therefore, that the following points should be investigated with care:

Ordinary volt-ampere accuracy.
Accuracy on inductive loads.
Accuracy on varying wave forms.
Accuracy on overload.
Accuracy on varying frequencies.
Influence on accuracy of variations of temperature, barometric conditions and humidity.

The second point, which is commonly given consideration in the selection of a meter, is that of life. This is a question which must depend more upon good judgment than upon any test which can be applied; for it is in reality no test of the enduring qualities of a meter to run it at excessively high speed for a relatively brief time. The life of a meter, in other words, cannot be measured by revolutions, irrespective of the speed of those revolutions; nor can it be determined by the speed at which it rotates alone.

Ninety per cent. of all the wear in a meter centers in the case of motor meters at the single jewel bearing, which is almost universal. The two chief factors which have influence upon the mere mechanical life are the weight of the moving mechanism and its speed, the variation of the area of the point of contact being, of course, always so small as to be out of the consideration.

A low-speed meter is usually the best meter, provided the speed be not carried so very low as to threaten the accuracy of the meter on light loads, by reason of being held up by intermittent friction in the form of dust or a spider. Practice has indicated that low speed is more conducive to long life than is light weight of the moving mechanism, although both are, of course, very important. More important than either, however, is the quality of the material used at the points of friction and the ease with which the friction parts can be renewed. The best of sapphire is barely good enough, and the pivot end must be of correct shape, burnished to the highest degree, and its point must be absolutely concentric with the center of movement.

More than half of the meter jewels which are destroyed are rendered useless, not by the rotary motion of the shaft, but by reciprocating motion of the shaft due to vibration. Hence it is very necessary that the jewels should be in some way cushioned, for vibration cannot be always avoided.

These are all, I admit, mechanical considerations, but they compass much of failure or success in electric metering. The purely electrical features of the meter contribute no grave factor of consideration in connection with the life question, always supposing that the copper is ample and the potential windings are so distributed and so ventilated as to preclude a burnout.

Passing over the central station man's third factor for consideration, that of the best unit of measurement, as one which is practically a closed question, we are brought face to face with his lamentable fourth point, the necessity that the meter should be able to withstand tampering. It is a regrettable fact, that this is a consideration which is coming daily into more prominence; but light has to to be sold to all sorts and conditions of people; and apparently the transgressor against meters is even more common than the transgressor against taxes; and this is a growing evil, largely, perhaps, because of the lax conditions of the laws which can be invoked to protect the meter owner in many of our states.

The methods which are commonly practiced in tampering with meters can scarcely form any proper part of a technical paper; but as this paper may go into the hands of some who need the knowledge to guard themselves and their interests, it can do no harm to briefly state the common methods used, not only that they may be guarded against, but also that meters may be selected which lend themselves least readily to such practices. It is not unusual to place large masses of iron above, below or at the side of meters, but this practice is falling somewhat into disrepute among its advocates, since even they have in time discovered that there is a class of meter which it accelerates.

Electromagnets, drawing their energy from the circuits under measurement and used as the iron was formerly used, are now not uncommon, and it is difficult to prove in court deliberate evil intent.

Meter covers and bases are drilled and wires, broom straws and the like inserted. Covers are pried up and healthy colonies of spiders introduced.

Ingenious individuals have even been reported as finding profit in a clever apparatus for injecting fine iron filings into meters by means of a bellows.

All of these things need to be watched for and guarded against.

The question of installation and care of meters is a wide subject, and in connection with it I shall endeavor to mention only a few salient points, selecting those which are most commonly overlooked or neglected.

The most radical cause of trouble in connection with installation is vibration and the consequent reciprocating motion of the shaft; for this reason the most solid of foundations should be selected, the neighborhood of moving machinery should be avoided, as should partitions of light construction in which doors are located. The rhythmic vibration of moving machinery is infinitely more dangerous than occasional heavy shocks.

Meters should be installed as near to the foundation as possible, not as is now quite common, at the top of buildings, where the amplitude of all vibrations is of course much greater.

Locations where great variations of temperature occur are undesirable. For this reason also, basements are preferable to attics.

A very common error, causing the loss of very many meters annually, by the burning out of the potential circuits, occurs in connection with the metering of power delivered to motors. In the effort to save the very trivial amount of energy passing through a potential circuit, it is very common to install meters on the motor side of the controlling switch. This not only exposes the meter to the full force of the field discharge, but it also results in the constant cooling and heating of the potential winding, and the resultant expansion and contraction chafes and weakens the insulation and also weakens the wire itself at the turns, opening the path for a final breakdown either by a lightning discharge or by a field discharge.

As to care of meters, it is a fallacy to suppose, as many insist upon doing to-day, that meters should require no care whatever. Almost all meters will continue operative for a very long period without any care whatever; but the cost of a cleaning and testing visit twice annually is trivial as compared with the good results which follow such a system, by reason of the better light load accuracy obtained. It is not, I think, too strong a statement to say that such a system will have an influence for good, amounting to from three to five per cent. on the meter readings annually.

Central station managements have probably given more attention to systematic methods of meter reading than to any other one point contributing to success. The old and faulty plan of reading the dials of a meter at the time of the visit to the meter, is fast giving place to the better system, which provides the reader with a fac-simile of the meter dial in blank upon a page of his meter book. This fac-simile is roughly marked in pencil to indicate the position of the hand at the time of the visit. These fac-similes are taken into the office and are all read by one individual who is an expert in meter reading, and who sets down the consumption under the fac-simile on each page. Such a system commonly reduces the errors from about 10 per cent. per month, where they not uncommonly stood under the old system, to materially less than one per cent. under the new; for surprising as it may seem, it is an extremely easy thing to make mistakes in reading meter dials.

In changing from the old and not infrequently popular contract system, a good many central stations in the earlier days made the grave blunder of going on to the new basis during the winter months, with the result that the highest bills of the year reached the customer after a long period of indulgence under the contract system, and the result at times proved temporarily disastrous.

Even to-day the pernicious influence of uniform bills the year through, which was created by the contract system, still lingers; and the proportion of customers who complain because their winter bills are materially higher than their autumn and summer bills is quite considerable.

It will be said that the explanation is sufficiently simple; but, unfortunately, however good and however simple the explanation, it has proved no simple matter to secure its acceptance and credence. I have lately been much impressed by a system which has recently been adopted by a prominent western company to at least partially offset this difficulty.

1. Read at the fourteenth general meeting of the American Institute of Electrical Engineers, Eliot, Me., July 27, 1897.

During the months which are growing darker, they read their meters a day or two earlier each month, thus arbitrarily creating shorter months, while as the year progresses to the period of lighter days, the months are lengthened. This somewhat tends to even up the bill, is apparently quite as satisfactory to the customer, and is certainly entirely just and has created a very great falling off in the complaint list, for the character of the complaint keeps pace with the period of the year. Out of the hundreds of complaints which I receive annually, I find that by far the greater proportion in the summer are of slow meters and in the winter of fast meters.

I do not feel that I shall be doing justice to my subject, should I fail to make at least brief mention of the application of meters to the measurement of station output.

The gas companies to whom all central stations look for precedents, long ago found it imperative that they should have some means of determining just how much of their commodity they produced, and sent out through their mains. In all commercial enterprises it is difficult to satisfactorily guide and control a business, unless there be some positive means of determining how much of anything is produced; and it is surely just as important to all electric lighting companies to know how much of their commodity they manufacture as for any other concern. Until quite recently it has not been possible to obtain recording meters sufficiently large to care for the heavy outputs which are now so common, but such meters are now readily obtainable.

The value of a system of station meters must necessarily prove very great, since it furnishes an absolute check system upon coal and water consumption, and engine and dynamo efficiency, while it also furnishes a ready means for comparison between station output, customers, meter indications, line losses, leaks and grounds.

In closing, some brief consideration at least is due to the new fields into which meters are reaching, and to the help special metering features may perhaps give indirectly as well as directly, to the amplifying of the business of electric light and power companies and to their more economic operation.

There has recently been much interesting discussion regarding the question of the flattening of the peak of the load either by the systematic modification of rates under special time contracts, governing the hours of burning, which does not concern the immediate subject matter of this paper, or by an actual modification in one of several forms in the meter itself, which should practically make the meter automatically control the modification of the rates in such a way as to gain the same end with certainty, as is aimed at in the special contract system.

While personally I have grave doubts regarding the actual feasibility of this plan commercially, in view of other and perhaps simpler methods by which it can be accomplished, I still have much respect for all of the various methods which have been proposed, and do not question that there will be at least many cases where they can be advantageously applied. Questions relating to the peak of the load, however, are subject to such great variations locally that a rule which would apply in New York might very readily fail in a system adopted in a smaller town.

It is quite obvious that the best double-rate meter will be that which tends to flatten the load curve of the station, not by oppressing or discouraging the user of light, who must have his light at the period of the peak, so much as by encouraging the use of light at other periods. We do not want to provide means for cutting off the peak so much as we want means for raising the rest of the curve to the same height as the peak. In my personal opinion, it is in this respect that perhaps the most ingenious of all these double-rate meters falls short. I refer to that form of two-rate meter which proportionately increases its rate of record at such time as the local load which it is measuring is highest. This discourages the use of light at the period of the local peak, and if the local peak and the station peak are coincident, it absolutely fulfills its purpose. But if they are not it fails, because instead of discouraging the use of a large amount of light at the time of the local peak, it should actually encourage it. Encouragement of local peaks, which are not coincident with the station peak, is beneficial to the central station in the highest degree, for it tends, as I have pointed out it should, to raise the general load curve toward the station peak magnitude.

If two-rate meters are to be used, therefore, I believe that their increased proportional speed should be dependent purely upon the occurrence of the station peak, and should bear no relation whatever to the occurring of the local peak. Such an arrangement can be secured in a number of ways, all of them simple and all of them effective.

One other feature of metering, which has recently come into existence in Europe, is about to make its appearance commercially in this country. It brings with it much of promise for the increase of profitable business for central stations. I refer to the prepayment meter system. The drop-a-nickel-in-the-slot-and-get-your-money's-worth meter. In gas practice this system has proved an unqualified success. I am informed that the London Gas Light company added 6,000 new customers of a profitable kind over and above their average annual growth in a single year, and that other companies have had similar experience.

There is in every large city a considerable area into which illuminating companies have been unable to go by reason of the untrustworthy character of the people who would there be their customers. In other words, because the people in these districts are a floating population without credit, coming to-day and going to-morrow, and yet ready and willing to buy electric light at high rates.

The prepayment meter throws open this new field and makes it immediately available; and here I predict for it wide usefulness.

Zamel Arc Light Current Timer.

The accompanying cut illustrates the Zamel arc light meter and current timer, a very simple yet valuable device for service in connecton with arc light central stations.

It is a well-known fact to those making contracts with stores for arc light service that the customer often declines and will not insert a light in his

ZAMEL ARC LIGHT CURRENT TIMER.

establishment on a contract basis. The customer prefers and, in fact, oftentimes demands, that the lighting company allow him to pay for his arc light by the hour or half hour, in a word, pay for what he uses.

The Zamel arc light timer was brought out by the Zamel Arc Light Meter company of 266 Blue Island avenue, Chicago, to overcome the difficulty here described. The meter is inserted in circuit in series with an arc lamp or any given number of lamps in any particular establishment. When the lights are turned on the meter starts its operation; and when the lamps are turned off the meter ceases to register, thus showing the customer, on its face, as it were, an accurate registration of the number of hours the light or lights were used.

As under this system the charge is so much per hour or fraction of an hour, it will be easily seen that the customer knows and need pay for only the actual amount of light used.

The device is exceedingly simple, and it is its simplicity that makes it evident to anyone examining it that the meter should prove an eminently valuable and reliable adjunct to any arc light central station. The main feature of the meter is the method through which the clock is started and stopped. This portion of the mechanism is positive in its action, and it is difficult to see how it could possibly get out of order. The Zamel company claims that this meter, or "timer," as it is more properly called, has been tested by several companies and found to operate in a perfectly reliable manner. The meter will register 144 hours. It is figured that through its use, and having the customer turn the light on or off as it is needed, there is saved the salary of a man to patrol circuits to shut off 10 o'clock or other earlier lights, and the lighting company is also enabled to place new contracts with consumers who would not go on a monthly schedule.

Heavy-duty Engine.

The cycloidal heavy-duty engine illustrated herewith was designed to meet the demand for a moderately high speed engine, which can be directly coupled to electric generators and operated with the highest degree of steam economy. The showing which this engine has already made for itself is highly satisfactory and has commanded the attention of steam and electrical engineers. Careful tests have convinced its builders that it is more economical than the Corliss type of engine, and without having the restriction of comparatively slow speeds imperative with the Corliss style of releasing valve gear.

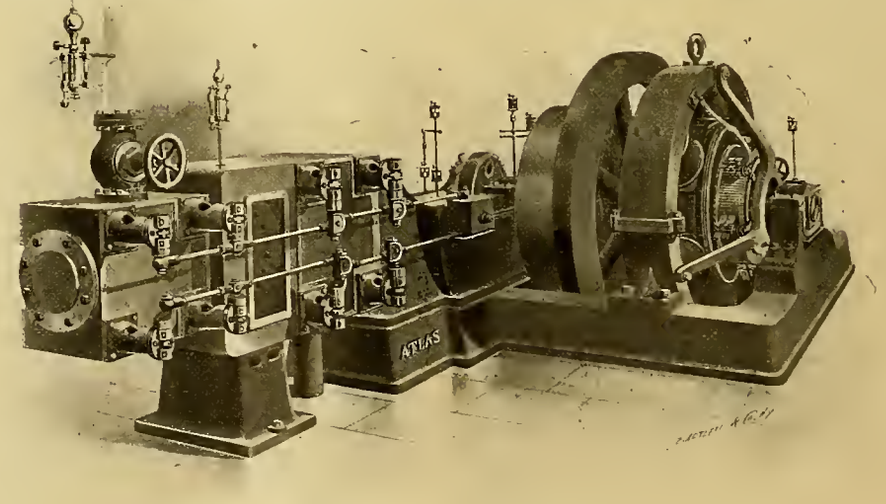
The general appearance of a direct-coupled unit is shown by the cut. The engine is designed for the heaviest kind of duty; the bed plate is massive and has removable, adjustable main bearings. All bearings, pins and wearing surfaces are very large and carefully finished; cylinders are steam jacketed and fitted with two admission and two exhaust valves, all of the multiported gridiron type, having flat wearing surfaces and removable seats. Admission and exhaust valves are separately operated, the admission valves being closed by direct steam pressure. Steam ports are very short and direct, and the steam clearance is reduced to a minimum. This valve gear is capable of very close adjustment; valves are quick opening and closing, very short travel, and give a long range cut-off.

The engine is fitted with the latest improved oiling devices, and can be thoroughly lubricated while under continuous running at full speed. The governor is of the inertia type, is mounted on the main shaft and gives extremely close regulation.

The engine can be furnished either simple or compound, direct-coupled to generator or direct-belted if desired.

The Atlas Engine Works of Indianapolis designed and built this engine. They have a special department with the best methods and appliances for the manufacture of high-grade engines. This company has also recently brought out the improved Atlas-Corliss engine.

A. M. Morse is the manager of the Chicago office, at 1108-9 Marquette building.



HEAVY-DUTY ENGINE.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the Western Electrician.]

M. M. Marshall, manager of the Des Moines office of the Iowa Telephone company, has resigned.

The Northwestern Telephone Exchange company is having some trouble with the farmers along its proposed line from Minneapolis to Wilmar, Minn., in getting a right of way.

The Sibley County Telephone company will build a line from Arlington, Minn., to New Auburn, Minn., if sufficient stock is subscribed.

The Iowa Telephone company will move its offices in Des Moines, Ia., to the Globe block.

The Southwestern Minnesota Telephone company of Pipestone, Minn., has been incorporated with $30,000 capital stock.

The Northwestern Telephone Exchange company has filed amended articles with the secretary of state in St. Paul, increasing its capital stock to $3,000,000.

The Northwestern Telephone company of Winona, Minn., has refitted its offices and put in a new metallic switchboard.

E. S. H. Johnson is an applicant for a telephone franchise at Gaylord, Minn.

The Iowa Telephone company's exchange at Eagle Grove, Ia., will be in operation by September 1st.

New Governor of the Ball Engine Company.

Recent developments in connection with electric lighting in office buildings necessitate such exacting service as to allow only the minutest variation of speed under widely varying loads and changing pressures. Not only must the speed be uniform, but it must remain so during the period of the change. To meet these new and rigid requirements, the Ball Engine company, Erie, Pa., has, after months of experiment, perfected a governor which, it is said, in every way fulfills the demands referred to, with the additional beauty of extreme simplicity. This governor, shown by the cut, is an adaptation of the Rites governor system. Not only does this governor regulate perfectly, as is claimed, but with an extraordinarily rapid adjustment and without instability or surging.

The centrifugal element is combined with an inertia element relatively so great that instant and extreme changes of load are immediately provided for without waiting for the otherwise necessary manifestation of centrifugal force. The entire governor consists of but a single moving piece, suspended upon one pivotal point, thereby reducing the friction to a minimum, and with no joints to interfere with the best action of the governor. The suspension pin or pivotal point is made of hardened crucible steel. The suspension-pin eye is lined with phosphor bronze, and the little lubrication that is required is accomplished by forcing grease, by means of a compression grease cup, into a number or recesses arranged around the bore of the bush. The extreme simplicity of this governor will recommend it to users of engines, and to this is joined the claim of perfect regulation.

Automatic Safety Rheostat.

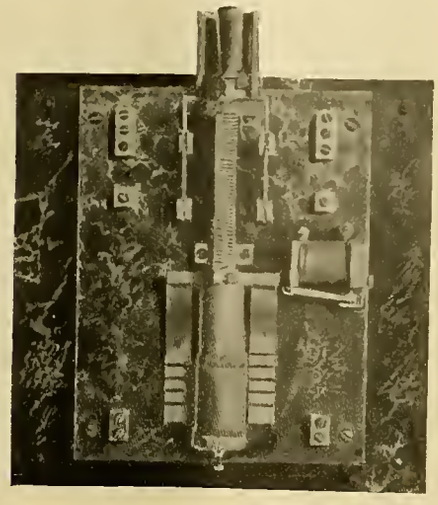
The rheostat herewith illustrated is made by the American Rheostat company of Milwaukee as a motor starter, and is automatic in operation, merely requiring the closing of the switch. The device comprises a double-pole knife switch, fuse block, release magnet, overload magnet and automatic circuit breaker, all on one slate front. The operator closes the switch, pressing the handle somewhat, which brings a plate connected with the switch in contact with the stem of the plunger, and thereby removes the pressure from the latch. This being done, the magnet immediately draws the latch over, and on letting go of the handle of the switch it is retained by the latch, if there is current passing the fields, otherwise it will not catch the latch. If the switch is retained the resistance is automatically cut out of circuit. If an overload occurs, the overload magnet acts and releases the latch, thereby opening the double-pole knife switch. If from any cause the resistance is cut out of circuit when the knife switch is open, it is impossible to close the knife switch. If on closing the switch the current is excessive, thereby causing the overload to act, it will simply prevent the cutting out of resistance until the overload drops, when the latch will retain the knife switch, and the resistance will be automatically cut out of circuit. With this rheostat the knife switch, fuse block, circuit breaker and accompanying switchboard and connnections are all done away with.

NEW GOVERNOR OF THE BALL ENGINE COMPANY.

Advance Stem Gas Burner.

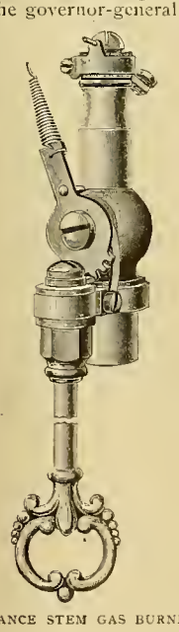
The accompanying cut illustrates the Advance burner, which is claimed by the manufacturer to be meeting with a large sale. The burner is operated in the same manner as the ordinary gas key. A quarter-turn opens the gas-cock and operates the arm, which creates a spark to ignite the gas; a partial reverse motion serves to diminish the size of the flame and a full quarter-turn to extinguish it. While the manipulation of the burner is very easy and simple in comparison with that of the ordinary pendant burner, the greatest advantage is in the impossibility of a short-circuit occurring during its operation. This is obviated by a simple device which causes the movable electrodes to pass under the fixed electrode when the gas is being extinguished without making contact.

The mechanical details of the burner have been carefully considered, resulting in a device which is strong, well made, requires no oiling, and is not affected by dust. The burner is now manufactured in the following styles: Straight stem as illustrated, side lever, straight stem and side lever candle, and straight stem and side lever Argand.



AUTOMATIC SAFETY RHEOSTAT.

The stems are made in different lengths. Insulating bushings are also fitted to any of these styles, which do not increase the length of the burner. The manufacturer of this burner is the Electric Gas Lighting company, 193 Devonshire street, Boston, Mass.



ADVANCE STEM GAS BURNER.

Plans for Telegraphic Communication with the Klondike.

The Canadian government has submitted formal proposals to the government of the United States to establish communication with the Klondike region in Alaska by the construction of a telegraph line from the head of winter navigation on the Lynn Canal, in the center of the Klondike district. The proposals have been approved by the British principal secretary of state for foreign affairs, and were forwarded by the governor-general of Canada, through the British embassy, to Washington, where they are now in possession of the Interior Department. The proposals, while reserving the right of either country pending the settlement of the international boundary line between the United States and Canada south of Mount St. Elias, urge the expediency of establishing a permanent route, giving access to the interior at all seasons of the year. The most feasible route, in the judgment of the Canadian authorities, would be to start from the head of winter navigation on the Lynn Canal (the body of water running from near Juneau up beyond Dyea and Chilkoot, forming part of the present overland route), crossing the mountains by White Pass or any other pass which may seem more accessible, and proceed northward to Fort Selkirk, thence to Klondike. The Canadian government asserts its readiness to undertake to open communication by constructing a telegraph line from the head of winter navigation on the Lynn Canal, traversing a distance of 80 miles across the summit of the mountain range, where a trail can be followed to Fort Selkirk and Klondike.

Tabulated Prices of Electrical Supplies for the Government.

When the different departments of the government advertise in the spring of the year for their annual supplies, the amounts of the different articles wanted are generally so large and the specifications so voluminous, that, after the bid opening is held, it takes quite a long time to properly schedule or tabulate the proposals received, and, consequently, as a rule, it is late in the summer when the result of the bid opening is made public; after that the contracts are awarded. This is the case with the Government Printing Office, which annually purchases quite a quantity of electrical supplies of various kinds. The tabulation of the bids for supplying electrical material and supplies to the bureau has just been completed and is as follows:

Incandescent Lamps of 16 Candle Power (110 volts, 50 watts).

	Each.
James S. Barron & Co., New York city	$ 0.17
The Universal Supply company, New York city	.20
Beacon Lamp company, New Brunswick, N. J.	.165
The Columbia Incandescent Lamp company, St. Louis, Mo	.20
General Electric company, Philadelphia	.20
Vallee Bros. & Co., Philadelphia	.16
Sawyer-Man Electric company, Allegheny, Pa.	.18
The Perkins Electric Switch Manufacturing company, Hartford, Conn	.18
M. Du Perow, Washington, D. C	.20

Incandescent Lamps of 25 Candle Power (110 volts, 78 watts).

	Each.
James S. Barron & Co, New York city	$ 0.21
The Universal Supply company, New York city	.22
Beacon Lamp company, New Brunswick, N. J.	.20
The Columbia Incandescent Lamp company, St. Louis, Mo	.20
General Electric company, Philadelphia	.20
Vallee Bros. & Co., Philadelphia	.16
Sawyer-Man Electric company, Allegheny, Pa.	.18
The Perkins Electric Switch Manufacturing company, Hartford, Conn	.20
M. Du Perow, Washington, D. C	.20

Incandescent Lamps of 32 Candle Power (110 volts, 100 watts).

	Each.
James S. Barron & Co., New York city	$ 0.30
The Universal Supply company, New York city	.32
Beacon Lamp company, New Brunswick, N. J.	.26
The Columbia Incandescent Lamp company, St. Louis	.30
General Electric company, Philadelphia	.30
Sawyer-Man Electric company, Allegheny, Pa.	.28
Vallee Bros. & Co., Philadelphia	.27
The Perkins Electric Switch Manufacturing company, Hartford, Conn	.27
M. Du Perow, Washington, D.C	.30

Rosettes for Cleat Work.

	Each.
James S. Barron & Co., New York city	$ 0.08
Royce & Marean, Washington, D. C	.21
The Universal Supply company, New York city	.10
General Electric company, Philadelphia	.11
Vallee Bros. & Co., Philadelphia	.105
The Perkins Electric Switch Manufacturing company, Hartford, Conn	.10
Anchor Electric company, Boston	.08
M. Du Perow, Washington, D. C	.10

Rosettes for Molding Work.

	Each.
James S. Barron, New York city	$ 0.0775
Royce & Marean, Washington, D. C	.11
The Universal Supply company, New York city	.10
General Electric company, Philadelphia	.11
Vallee Bros. & Co., Philadelphia	.105
The Perkins Electric Switch Manufacturing company, Hartford, Conn	.10
M. Du Perow, Washington, D. C	.10

Porcelain Cleats (two-wire).

	Per 1,000.
James S. Barron & Co., New York city	$13.00
Royce & Marean, Washington, D. C	16.00
The Universal Supply company, New York city	15.00
General Electric company, Philadelphia	15.00
Vallee Bros. & Co., Philadelphia	8.00
Anchor Electric company, Boston	9.00
M. Du Perow, Washington, D. C	20.00

Hard Rubber Bushings for Edison Sockets.

	Per 1,000.
James S. Barron & Co., New York city	$ 0 40
Royce & Marean, Washington, D. C	1.20
The Universal Supply company, New York city	.75
General Electric company, Philadelphia	.375
Vallee Bros. & Co., Philadelphia	2.00
M. Du Perow, Washington, D. C	1.00

Wooden Socket Handles.

	Each.
James S. Barron & Co., New York city	$ 0.125
Royce & Marean, Washington, D. C	.01
The Universal Supply company, Philadelphia	.01
E. P. Gleason Manufacturing company, New York city	.15
Vallee Bros. & Co., Philadelphia	.02
M. Du Perow, Washington, D. C	.015

Cord Adjusters.

	Each.
James S. Barron & Co., New York city	$ 0.005
Royce & Marean, Washington, D. C	.005
The Universal Supply company, New York city	.005
General Electric company, Philadelphia	.005
E. P. Gleason Manufacturing company, New York city	.005
Vallee Bros. & Co., Philadelphia	.02
Anchor Electric company, Boston, Mass	.75
M. Du Perow, Washington, D. C	.01

Attachment Plugs to fit Edison Sockets.

	Each.
James S. Barron & Co., New York city	$ 0.10
Royce & Marean, Washington, D. C	.13
The Universal Supply company, New York city	.17
General Electric company, Philadelphia	.15
E. P. Gleason Manufacturing company, New York city	.10
Vallee Bros. & Co., Philadelphia	.11
The Perkins Electric Switch Manufacturing company, Hartford, Conn	.10
M. Du Perow, Washington, D. C	.12

Key Sockets, Polished Brass, Edison Type.

	Each.
James S. Barron & Co., New York city	$ 0.147
Royce & Marean, Washington, D. C	.15
The Universal Supply company, New York city	.17
General Electric company, Philadelphia	.145
E. P. Gleason Manufacturing company, New York city	.155
Vallee Bros. & Co., Philadelphia	.16
M. Du Perow, Washington, D. C	.145

Keyless Sockets, Polished Brass, Edison Type. — Each.

James S. Barron, New York city	$ 0.135
Royce & Marean, Washington, D. C	.13
The Universal Supply company, New York city	.18
General Electric company, Philadelphia	.13
Vallee Bros. & Co., Philadelphia	.14
M. Du Perow, Washington, D. C	.125

Keyless Wall Sockets, Edison Type. — Each.

James S. Barron & Co., New York city	$ 0.18
Royce & Marean, Washington, D. C	.29
The Universal Supply company, New York city	.22
General Electric company, Philadelphia	.15
Vallee Bros. & Co., Philadelphia	.15
M. Du Perow, Washington, D. C	.135

Grimshaw Tape, Black, three-fourths inch wide. — Per Pound.

James S. Barron & Co., New York city	$ 0.59
Royce & Marean, Washington, D. C	.63
The Universal Supply company, New York city	.63
Vallee Bros. & Co., Philadelphia	.78
The Safety Insulated Wire & Cable company, New York city	.45
M. Du Perow, Washington, D. C	.62

Pure Rubber Tape. — Per Pound.

James S. Barron & Co., New York city	$ 0.40
Royce & Marean, Washington, D. C	.65
The Universal Supply company, New York city	.87
Vallee Bros. & Co., Philadelphia	.75
M Du Perow, Washington, D. C	.70

Shade Holders, 3¼ inch, Gleason Clamp. — Per Gross.

James S. Barron & Co., New York city	$ 9.00
Royce & Marean, Washington, D. C	7.90
The Universal Supply company, New York city	8.50
E P. Gleason Manufacturing company, New York city	7.88
Vallee Bros. & Co., Philadelphia	7.50
The E. F Brooks company, Washington, D. C	15.00
M. Du Perow, Washington, D. C	6.50

Cut-outs No. 61,465. — Each

James S. Barron & Co., New York city	$ 0 37
Royce & Marean, Washington, D. C	.39
The Universal Supply company, New York city	.40
General Electric company, Philadelphia	.35
Vallee Bros. & Co., Philadelphia	.35

Cut-outs No. 61,478. — Each.

James. S. Barron & Co., New York city	$ 0.80
General Electric company, Philadelphia	.75
Royce & Marean, Washington, D. C	.80
The Universal Supply company, New York city	.85
Vallee Bros. & Co., Philadelphia	.75

Cut-outs No. 61,245. — Each.

James S. Barron & Co., New York city	$ 1.10
Royce & Marean, Washington, D. C	1.10
The Universal Supply company, New York city	1.15
General Electric company, Philadelphia	1.00
Vallee Bros. & Co., Philadelphia	1.00

Cut-outs No. 62,835. — Each.

James S. Barron & Co., New York city	$ 0.60
Royce & Marean, Washington, D. C	.55
The Universal Supply company, New York city	1.15
General Electric company, Philadelphia	.50
Vallee Bros. & Co., Philadelphia	.50

Lamp Cord, No. 18 B. & S. Gauge. — Per Yard.

Royce & Marean, Washington, D. C	$0 .06
The Universal Supply company, New York city	.05
General Electric company, Philadelphia	.045
Washburn & Moen Manufacturing company, Philadelphia	.032
The Safety Insulated Wire and Cable company, New York city	.048
M. Du Perow, Washington, D. C	.026

Shawmut Fuse Wire (1 ampere.) — Per Pound.

James S. Barron & Co., New York city	$0 .50
The Universal Supply company, New York city	.50
Vallee Bros. & Co., Philadelphia	.55
M. Du Perow, Washington, D. C	.50

Shawmut Fuse Wire (10 ampere). — Per Pound.

James S. Barron & Co., New York city	$0 .44
The Universal Supply company, New York city	.40
Vallee Bros. & Co., Philadelphia	.45
M. Du Perow, Washington D. C.	.42

Shawmut Fuse Wire (20 ampere). — Per Pound.

James S. Barron & Co., New York city	$0 .39
The Universal Supply company, New York city	.35
Vallee Bros. & Co., Philadelphia	.45
M. Du Perow, Washington, D. C	.37

Shawmut Fuse Wire (50 ampere). — Per Pound.

James S. Barron & Co., New York city	$0 .39
The Universal Supply company, New York city	.35
Vallee Bros. & Co., Philadelphia	.45
M. Du Perow, Washington, D. C	.37

Shawmut Fuse Wire (175 ampere). — Per Pound.

James S. Barron & Co., New York city	$0 .39
The Universal Supply company, New York city	.35
Vallee Bros. & Co., Philadelphia	.35
M. Du Perow, Washington, D. C	.37

Shawmut Fuse Ribbon (100 ampere). — Per Pound.

James S. Barron & Co., New York city	$0 .35
The Universal Supply company, New York city	.30
Vallee Bros. & Co., Philadelphia	.40
M. Du Perow, Washington, D. C	.34

Shawmut Fuse Ribbon (150 ampere). — Per Pound.

James S. Barron & Co., New York city	$0 .35
The Universal Supply Co., New York city	.30
Vallee Bros. & Co., Philadelphia	.40
M. Du Perow, Washington, D. C.	.34

Shawmut Fuse Ribbon (200 ampere). — Per Pound.

James S. Barron & Co., New York city	$0 .35
The Universal Supply company, New York city	.30
Vallee Bros. & Co., Philadelphia	.40
M. Du Perow, Washington, D. C	.34

Shawmut Fuse Ribbon (250 ampere). — Per Pound.

James S. Barron & Co., New York city	$0 .35
The Universal Supply company, New York city	.30
Vallee Bros. & Co., Philadelphia	.40
M. Du Perow, Washington, D. C	.34

Fuse Links (10 ampere, 1⅝ inches from center to center). Per 100.

James S. Barron & Co., New York city	$ 4.40
The Universal Supply company, New York	4 00
Vallee Bros. & Co., Philadelphia	3.00
M. Du Perow, Washington, D. C	4.50

Fuse Links (30 ampere, 1⅝ inches from center to center). Per 100.

James S. Barron & Co., New York city	$ 4.40
The Universal Supply company, New York city	4.50
Vallee Bros. & Co., Philadelphia	6.00
M Du Perow, Washington, D. C	4.50

Fuse Links (50 ampere, 1⅝ inches from center to center). Per 100.

James S. Barron & Co., New York city	$ 4.40
The Universal Supply company, New York city	5.00
Vallee Bros. & Co., Philadelphia	7.20
M. Du Perow, Washington, D. C	4.50

Fuse Links (100 ampere, 4½ inches from center to center). Per 100.

James S. Barron & Co., New York city	$ 6.60
The Universal Supply company, New York city	7.25
Vallee Bros. & Co., Philadelphia	9.00
M. Du Perow, Washington, D. C	7.25

Fuse Links (150 ampere, 4½ inches from center to center). Per 100.

James S. Barron & Co., New York city	$ 6.60
The Universal Supply company, New York city	7.50
Vallee Bros. & Co., Philadelphia	9.00
M. Du Perow, Washington, D. C	7.25

Fuse Links (200 ampere, 4½ inches from center to center). Per 100.

James S. Barron & Co., New York city	$ 6.60
The Universal Supply company, New York city	8 00
Vallee Bros. & Co., Philadelphia	18 00
M. Du Perow, Washington, D. C	7.25

Fire and Moisture Proof Wire, No. 12. — Per 100 Feet.

The Manhattan Supply company, New York city	$0 .625
Vallee Bros. & Co., Philadelphia	.72
Washburn & Moen Manufacturing company, Philadelphia	.50
The Safety Insulated Wire and Cable company, New York city	.696
M. Du Perow, Washington, D. C	.75

Fire and Moisture Proof Wire, No. 10. — Per 100 Feet.

The Manhattan Supply company, New York city	$ 1.04
Vallee Bros. & Co., Philadelphia	.96
Washburn & Moen Manufacturing company, Philadelphia	.72
The Safety Insulated Wire and Cable company, New York city	.969
M. Du Perow, Washington, D. C	1.15

Fire and Moisture Proof Wire, No. 8. — Per 100 Feet.

The Manhattan Supply company, New York city	$ 1.355
Vallee Bros. & Co., Philadelphia	1.20
Washburn & Moen Manufacturing company, Philadelphia	.95
The Safety Insulated Wire and Cable company, New York city	1.18
M. Du Perow, Washington, D. C	1.50

Fire and Moisture Proof Wire, No. 6. — Per 100 Feet.

The Manhattan Supply company, New York city	$ 1.8525
Vallee Bros. & Co., Philadelphia	1.65
Washburn & Moen Manufacturing company, Philadelphia	1.40
The Safety Insulated Wire and Cable company, New York city	1.90
M. Du Perow, Washington, D. C	1.95

Rubber Wire, No. 12. — Per 100 Feet.

Vallee Bros. & Co., Philadelphia	$ 1.40
Washburn & Moen Manufacturing company, Philadelphia	1.50
Standard Underground Cable company, Pittsburg	1.15
The Safety Insulated Wire and Cable company, New York city	1.25
M. Du Perow, Washington, D. C	2.00

Rubber Wire, No. 10. — Per 100 Feet.

Vallee Bros. & Co., Philadelphia	$ 1.80
Washburn & Moen Manufacturing company, Philadelphia	1.85
Standard Underground Cable company, Pittsburg	1.60
The Safety Insulated Wire and Cable company, New York city	1.75
M. Du Perow, Washington, D. C	2.275

Rubber Wire, No. 8. — Per 100 Feet.

Vallee Bros. & Co., Philadelphia	$ 2.10
Washburn & Moen Manufacturing company, Philadelphia	2.45
Standard Underground Cable company, Pittsburg	1.95
The Safety Insulated Wire and Cable company, New York city	2.00
M. Du Perow, Washington, D. C	3.15

Rubber Wire, No. 6. — Per 100 Feet.

Vallee Bros. & Co., Philadelphia	$ 3.00
Washburn & Moen Manufacturing company, Philadelphia	3.00
Standard Underground Cable company, Pittsburg	3.00
The Safety Insulated Wire and Cable company, New York city	3.50
M. Du Perow, Washington, D. C	6.375

Engineers' Club of Chicago.

Incorporated last month, the Engineers' Club of Chicago has been organized for "the advancement of engineering in its several branches, the professional improvement of its members, and the encouragement of social intercourse among men of practical science." Regular meetings for the discussion of technical subjects will be held at least once a month, and permanent quarters have been established at 1800 Fisher building. Membership is limited to "citizens of the United States who are actively engaged or interested in the management, operation, sale or manufacture of engines, boilers, pumps and electrical machinery, or any of the legitimate supplies and accessories that go to make up the whole or part of power generating or transmitting plants." The dues are small, and the management is vested in a board of seven trustees, consisting of the president, vice-president and secretary of the club and four other members. The trustees for 1897 are: M. O. Kasson, the president; C. W. Naylor, the vice-president; Lewis M. Ellison, the secretary and treasurer, and C. DeWitt Wines, B. W. Thurtell, James McDonough and T. J. McMaster.

Alley "L" Electrical Equipment.

Continued tests of the Sprague system of independent units and central motor control, as applied to railway operation in the experimental train at Schenectady, seem to be equally as successful as the first. The records of control, speed and acceleration are all good, and there appears to be no question that Mr. Sprague has demonstrated the general excellence of his plan, with the result of its adoption by the South Side Elevated Railway company of Chicago. The contact rails for the new system on the Alley "L" are now being laid, and the tracks are being bonded. The work of fitting for electrical operation will be steadily prosecuted from this time forward.

Some Day, Some Day.

[From the London Electrical Review.]

On the whole, we have, as must be obvious to every fair-minded man, an enormous amount to learn from American engineers in tramway matters; their experience, gained at heavy cost and with hard work, is made available for our benefit, and the meed of thanks should not, therefore, be ungenerous. We pay it by going to the States for motors, controllers; sometimes engines; even cars; poles, too, in a few cases; while overhead fittings for English tramways have to date universally crossed the Atlantic. Perhaps the time may not be far distant when all these things will be made in England for cheapness and convenience, but the credit will even then be largely due to America for showing the way and building the rough foundations upon which English solidity and thoroughness of method will raise a superstructure of improvements.

Government Telegraph Demanded.

The Times-Democrat of New Orleans has issued a circular letter in support of its demand for a government telegraph service in which it says: "In the matter of telegraph tolls and charges, you have but to look over your bills to see that there has been no reduction in the last 10 years. The cost of poles and wires and the wages of employes have been cut down, and the service costs the Western Union not over 60 per cent. of what it cost in 1887, yet its tolls to-day are as high as they were then. Every other article of general consumption, food, clothing, fuel, etc., has fallen in price. The telegraph alone has made no reduction, in spite of the fact that it has profited more than any other line of service in the decline in the cost of the materials used by it, the wages paid its employes and the great improvement made in all electric and telegraphic machinery and implements, which enables it to send ten words off now with the same effort and cost it required to send off one a few years ago. If you compare your telegraph bills to-day with those of 10 years ago, you will find that they have doubled relatively in that time and are now from 10 to 20 per cent. of your gross expenses as compared with five or 10 per cent. in 1887. The business interests of the country have been plundered by this monopoly worse than the press, and have presented hundreds of petitions to Congress in favor of a postal telegraph system operated, like that of England, as part of the Postoffice Department, which has given such satisfaction to the press and people of that country. Congress, on its part, in spite of the Western Union lobby, has been favorably disposed toward the change. Fourteen congressional committees have, at different times, reported in favor of a postal telegraph, and Congress on one occasion passed the necessary bill providing for its establishment. On all these occasions the Western Union was saved by the press, which was unwilling to see the telegraph pass under the control of the government, fearing that it might become tangled up in politics. Now that this fear no longer exists, is it not the duty of the press, recognizing that there is no possibility of improvement from a company whose only idea is to squeeze as much money out of its patrons as possible, and which, believing itself firmly intrenched in its monopoly, is unwilling to grant any concession or to make any improvement in its service, to demand the only relief in sight—that the United States resume the control of the telegraph, which it possessed half a century ago, and which England, France and nearly all the European countries exercise to-day with the greatest general satisfaction?"

The Synchronograph in England.

A cable message from London says that the English postoffice officials are deeply interested in the experiments in telegraphy made by Prof. Crehore of Dartmouth College and Lieutenant Squier of the military school at Fortress Monroe. The inventors claimed that they could not secure facilities for long-distance operations in this country, and accordingly appealed to the British government for assistance. Mr. Preece placed the government plant at their disposal and directed the subordinates to give them every possible aid in making the trials over the London and Birmingham line. It is reported that the tests made have been entirely satisfactory.

An official of the British postoffice said: "I am surprised that more assistance is not given to inventors in the United States. England seems more friendly to American inventors than their own home."

The inventors may go to France and Germany to show their scheme to the telegraph officials of the governments of those countries.

Failure of Electrical Service at Paterson.

Paterson, N. J., was deprived of electric lighting and trolley service last week when a huge bin that held 1,000 tons of coal burst in the Edison Electric Illuminating company's building. The coal, whose weight had burst the bin, poured from its gaping sides, buried two men and drove 18 more flying for their lives before it. The falling coal snapped off the great steam pipe that supplied the big engines in the building. The steam escaped, scorching, hissing, and added to the deafening din of the falling coal, to the danger and excitement. The company supplies Paterson with electricity, drives the cars on the trolley lines and lights the arc and incandescent lamps throughout the city. The instant the big engines ceased to move for lack of steam the lighting and transportation service was cut off.

Lord Kelvin's Views on Niagara Development.

[From the Niagara Falls correspondent of the Western Electrician.]

Lord Kelvin visited Niagara Falls last Sunday, and in company with Dr. Coleman Sellers looked upon the turbines and generators in the power plants there. It will be recalled that Lord Kelvin, then Sir William Thomson, was president of the International Niagara Commission, established in London, England, in June, 1890, for the purpose of examining plans for the then proposed Niagara development, and that the Niagara Falls Power company acted upon the suggestions of the commission. Despite Lord Kelvin's prominent connection with the project in its early stages, he had never, until Sunday, August 14th, looked upon the results of the development other than in pictures. For this reason, if for no other, this initial visit of the noted scientist and electrician to the great power plant at Niagara was replete with interest. Dr. Sellers, who also was a member of the International Niagara Commission, and who is now president of the Niagara Falls Power company, was at the Cataract House, prepared to be among the first to greet Lord Kelvin on his arrival at the Falls from New York, the trip from the metropolis having been made, much to Lord Kelvin's delight, on the New York Central's world-famous "Empire State Express." The greeting of the two men was full of feeling.

Over two decades had passed since Lord Kelvin was at the Falls before, and what changes those years had wrought! The year was 1876. The idea of using the waters of the Niagara was in many minds. Much had been written upon it. Several comparatively small factories were using power from the hydraulic canal, but the total amount of power so used was very small. The above facts were recited by Lord Kelvin by way of introduction to the interview, and then he was asked:

"You were originally inclined to believe that power could be transmitted much more economically by some new appliance rather than by shafting?"

"Yes. At the 50th annual meeting of the British Association I gave estimates of appliances by which power could be transmitted from Niagara Falls to a distance of 300 miles by single wire, but instead of a single wire 300 miles long the calculation would be applied to transmit 150 miles by wire and return, insulated metallic circuit, and I showed that it was only the question of the voltage used what would be the loss of energy in the wire. I gave an estimate on transmission with 80,000 volts, and I think about 20 per cent. would be lost on the way. A voltage of 80,000 would be possible, but neither then nor now would I advise the adoption of so high a voltage as that. There would be no difficulty in using 20,000 volts for transmission to a distance of 20 miles, and a fairly economical transmission to a distance of 40 miles. Forty miles could be realized, but most probably it would be much better for the factories to come to the power, or to come within 10 miles of the power, than to transmit to a great distance."

"You think the future of Niagara Falls is more assured by this power development than by anything else?"

"Yes. I think we already see the beginning of what is destined to grow into a great industrial district around Niagara Falls, within 10 or 20 miles of Niagara, both on the United States side and on the Canadian side. I do not prophesy anything, but I anticipate industry will advance on both sides of the border, and that the power of Niagara will be taken advantage of to any extent we may imagine.

" I have witnessed with great interest the advancement made by the Cataract Construction company with the project of using 120,000 horse power, and the actual realization of a large part of the project. Also the prospect in the near future of 50,000 horse power being actually generated by 10 turbines, and transmitted to distances from five to 20 miles, it may be farther, and to shorter distances.

"These units of power are what you recommended to the International Niagara Commission? It was decided by the commission that 5,000 horse power would be a possible amount of power to be transmitted?"

"I was chairman of the commission invited by the Cataract Construction company to meet in London and consider the project. That commission decided, or concluded, that 5,000 horse power unit for development of the power by a single turbine was practicable, although the greatest amount of horse power given by a single turbine before that was only 1,500 horse power. From this it will be seen that the Cataract Construction company and the commission had the courage to make a very great step in advance of anything that had been done before. Still, this was only looking into the future, and the commission left the development to the Cataract Construction company, after considering plans that had been given them by many of the greatest constructors of turbines and of electrical machinery. After carefully considering what could be done, either by electricity or compressed air or by hydraulic pressure, for transmitting power, the commission strongly recommended the choice of electrical transmission in preference to any other known or conceivable method. They did not express any opinion as to the nature of the electrical current which should be used, as they believed at that time that the state of the art was one of transition. It might be in the future turned one way or the other, and no one could predict exactly what could be developed.

"The Cataract Construction company has carried out the project left in its hands, and has taken advantage of great developments in electrical engineering, which have grown up since the sittings of the commissions. In the result, as we now have it in the power house of the Niagara Falls Power company and in the several factories, chiefly at present electro-chemical, which have sprung up around it within the last four years; in the electric supply of the tramways between Niagara Falls and Buffalo on the one side and Lewiston on the other, and in the local lighting of Niagara Falls, we have already a splendid installment of the work projected and now in progress for utilizing the great natural power of the place.

"Positively I have been intensely interested in all that I have seen here during the last three days, and I can scarcely find words adequate to express the great admiration which I feel for the inventiveness, the scientific care in design and the skill in execution which I have witnessed in the power house, and in some of the factories supplied by it. These results and the smooth and uninterrupted success in the actual working during the two years which have passed since the first of the dynamos commenced running in August, 1895, are largely due to the hearty and harmonious co-operation of the great electrical construction companies and their generous rivalry in assisting the scientific staffs of the Cataract Construction company and the Niagara Falls Power company.

"The originators of the work so far carried out and now in progress hold concessions for the development 450,000 horse power from the Niagara river. I do not myself believe any such limit will bind the use of this great natural gift, and I look forward to the time when the whole water from Lake Erie will find its way to the lower level of Lake Ontario through machinery doing more good for the world than that great benefit which we now possess in the contemplation of the splendid scene which we have presented before us at the present time by the waterfall of Niagara. I wish I could think it possible that I could live to see this grand development."

A well-known gentleman who was present and heard Lord Kelvin's words stated that it might be well for him to insert a saving clause in that statement, the gentleman having in mind the past unnecessary alarm about the beauty of the falls being impaired by power development, but Lord Kelvin grew more enthusiastic than at any previous time in the interview, and said:

"No. I do not hope that our children's children will ever see the Niagara cataract."

His enthusiasm over what he had seen while in the great power house was no doubt finding its way to expression, and these few words will portray how well he enjoyed his visit at the Falls.

"I may add," continued Lord Kelvin, "if it is not irrelevant to the questions you have put to me, that I look forward to a revival of both life and prosperity in the Highlands of Scotland, and the present crofters being succeeded by a happy, industrial population, occupied largely in manufactories, to be rendered possible by the utilization of all the water power of the country. The people there say that to do away with the Falls of Foyre is to supersede an industrious people for the porters and guides of tourists. It seems to me a happy thought that the poor people of the country will be industrious artisans, rather than mere guides and assistants to tourists."

"Am I to understand that it is your belief that the limit of power transmission with the present-day apparatus is 20 miles?"

"Forty miles. Rather let the factories come to the power, than the power go to the factory."

"How about lighting New York city by Niagara electricity,"

"Of course, with electric lighting, that is another question. You cannot bring New York to the Falls to be lighted, but you can bring factories to the Falls to be operated."

"Do you think it possible, then, to light New York from Niagara?"

"It would be too expensive. It could be done, but more than half of the current would be lost in transmission."

"Will electrical apparatus, in your opinion, undergo great changes?"

"No doubt there will be great improvements. There has been enormous improvement during the last five years, and it is not likely that the next five will be less progressive than the last."

"In your opinion, what is most needed in the electrical science to-day?"

"More and more of it."

This ended the interview, and Lord Kelvin and party departed with William B. Rankine, secretary of the Cataract Construction company, for a trip over the great Gorge road, where he had another opportunity to see what electricity is doing for the Niagara locality. While at the Falls Dr. Sellers was the constant companion of Lord Kelvin, and showed him every attention. With Lord Kelvin were Lady Kelvin, Dr. J. T. Bottomley, Lord Kelvin's nephew, and Mrs. Bottomley. They left Niagara Falls on Wednesday, August 18th, for Toronto, Ont., where Lord Kelvin attended the meeting of the British Association for the Advancement of Science.

CORRESPONDENCE.

New York Notes.

New York, August 17.—In the present stage, the tunnel scheme of rapid transit for the city of New York is in the hands of a commission appointed by the Supreme Court, which is taking testimony in relation to the cost and practicability of the road planned by the Rapid Transit Board. If the commission reports favorably to the Appellate Division of the Supreme Court, the business of awarding the franchise for the road and condemning property will be begun at once. The advocates and opponents of the road are represented by counsel, and the hearing promises to last for some time to come. The chief witness so far has been Mr. Parsons, the chief engineer for the Rapid Transit Commission, who produced a book of drawings, showing the general plans of the proposed road, with its routes and the profiles of the surface of the ground along these routes; also profiles of the proposed tunnels and elevated roads which will make up the two routes. He explained the difference between the present plans and those for the Broadway route which were rejected a year ago by the Supreme Court. The main differences, he said, were in avoiding that part of Broadway between the city hall and Thirty-fourth street, where the work of construction would have been enormously expensive and uncertain, and in substituting a great deal of elevated structure for the more expensive underground system. By the present plan there would be 20.03 miles of road built, reaching from and including a loop around the postoffice to the Kingsbridge station on the West Side and to Bronx Park and the Boston road on the East Side. This is nearly two miles more than the total length of the older routes, but has two miles less of four-track tunnel. Instead of costing $49,600,000, as Mr. Parsons had estimated for the Broadway route, the present one would cost not more than $32,600,000. Even this figure Mr. Parsons reduced, for he said that in making it up he had included the cost of putting in pipe galleries along the sides of the tunnel up Center and New Elm streets to Lafayette place and putting new pipes in the galleries, and besides this he had included the cost of facing the entire tunnel with fancy porcelain-covered brick and of much brickwork which he had since found could be replaced by concrete. The changes that might thus be made would bring the cost below $30,000,000. Interesting figures of the passenger traffic of New York were also presented by Mr. Parsons. The traffic on the surface railroads in 1896 amounted to 341,489,027 and on the elevated roads 184,793,636. This would make the total number of passengers carried on the elevated and surface roads last year 526,192,663. Mr. Parsons said that his idea was that the rate of speed should be about 25 miles an hour for express trains and 15 miles an hour for regular trains. A speed of 60 miles an hour might be attained with safety, he thought, by not making stops at stations.

Consolidation has been virtually effected by the American Air Power company and the Compressed Air Power company, and there is a rumor that this movement was effected in the interest of the Metropolitan Street Railway company, which is considering the pneumatic system, it is claimed, for some of the lines to be operated by mechanical or electrical power in place of horses. Probably the wish is father to the thought on the part of the compressed-air advocates, and it is likely that they are the ones who have started the talk. At any rate, no definite action has been taken. M. S.

PERSONAL.

W. A. Barbot, secretary and general manager of the Earls of Electra, of St. Louis, has been in Chicago several days.

William C. Woodward of the D. & W. Fuse company of Providence, R. I., is making a western trip and was a recent Chicago visitor.

Among the American visitors at the meeting of the British Association in Toronto was Dr. H. S. Carhart, professor of electrical engineering at the University of Michigan.

T. C. Penington, secretary and treasurer of the American Street Railway association, is in the East, arranging details for the annual gathering at Niagara Falls in October.

Ludwig Gutmann, electrical engineer of the Royal Electric company of Peoria, was in Chicago last week. Mr. Gutmann has just finished an extensive trip through the West.

Prof. R. B. Owens of the University of Nebraska passed through Chicago on Wednesday on his way to Lincoln, Neb. He states that the prospects for the success of the electrical department of the Omaha Exposition next year are bright, and judges from the preparations now making that the electrical display will be distinctly creditable to the industry.

Hugh J. Ellis, late of Ellis & Clark, a firm of electricians of Adelaide, Australia, has returned to the United States to engage in electrical work. Mr. Ellis, who designed the first dynamo built in South Australia, says that the electrical outlook in that colony is not particularly bright, but that

greater activity is reported from New South Wales and Victoria.

Louis K. Comstock, one of the best known of the electrical construction men of the West, has been appointed superintendent of construction for the Western Electric company of Chicago, succeeding Edward B. Ellicott.

Lord Kelvin, who crossed the ocean to attend the British Association meeting in Toronto, was, of course, interviewed in New York. If the reporter made a correct record of the conversation, his lordship is greatly interested in the plan for utilizing garbage as fuel in the production of electrical energy, particularly as practiced at Shoreditch in England. He is also reported as saying that telegraphy without wires is feasible for short distances.

ELECTRIC LIGHTING.

C. Wilbur Wiley of Beloit, Wis., will soon put in an electric light plant in Bedford, Iowa. Manufacturers may address him at Beloit.

The Common Council of the city of Niagara Falls, N. Y., will receive bids until November 1st for furnishing street arc lighting to the city for a period of five years from November 1, 1898. The estimated number of lamps is 300, and each is to be of 2,000 candle power. Informaton will be furnished by S. F. Arkush, the city clerk, on application.

ELECTRIC RAILWAYS.

"So far as the traveling public is concerned, the ideal method of transportation in a city's streets is the underground trolley," says the New York Sun, and it adds: "The sooner the desired permission is given to the Metropolitan Traction company to apply the trolley wherever it wants it, the better."

The street railway company of Lincoln, Neb., has given notice that it will discontinue operating the line because it cannot procure coal. It has been securing fuel at Mount Pulaski, but the operators there have served notice they can furnish no more coal. The electric light company still has a supply of coal on hand.

The Tradesmen's National Bank of New York surprised the managers of the Atlantic Highlands, Red Bank and Long Branch Electric Railroad company on August 13th by disconnecting the company's tracks and building a fence across the road at two points. The bank owns six lots now traversed by a double-track trolley road, and notified the trolley company that unless a settlement was made for the trespass action would be taken.

The balance sheet of the West Chicago Street Railroad company, just issued in connection with the recent application to list the securities of the company on the New York Stock Exchange, shows that the company has, in cash on hand and in banks, the large sum of $1,805,052.87. The cost of the road, equipment, right-of-way and construction is placed at $16,331,184.52, while the real estate is valued at $1,580,202.65. In round numbers, the capital stock is $13,000,000 and the bonds issued amount to $14,700,000.

The application of the Alley "L" for permission to change its motive power from steam to electricity should be hailed with delight, not only by the people who use that system, but also by those who live along the route, says the Chicago Chronicle, which adds that the disappearance of the smoke producers in the shape of the dummy engines of the line should make a wonderful difference in the atmosphere of the South Side. It will also make a difference to the passengers, for there will be no more black clouds of smoke and cinders blowing in at the windows as they ride.

The articles of incorporation of the Milwaukee and Waukesha Railway company were amended on August 16th by reducing the capital stock from $3,000,000 to $100,000. This action was taken for the purpose of overcoming an injunction restraining the company from entering into a contract for the construction of a strip of road, which was granted in the Circuit Court on the filing of a complaint by one of the stockholders, who alleged that 20 per cent. of the capital stock of the concern had not been actually paid into its treasury, as is required by the statutes of Wisconsin before a corporation can transact business. It was stated by the officers of the company that work would begin immediately on the electric road it contemplates building in Milwaukee. The various injunctions obtained in the courts of the county restraining the company from proceeding with the work of construction have had the effect of extending the time allowed the concern in its franchise in which to begin the work of laying track.

Judgment for $1,786 was entered against the General Electric Street Railway company of Chicago last week in favor of Edwin F. Getchell, as the defendant failed to file a plea in time, and the court refused to allow further delay. Getchell sued for services which he says he rendered for the company in obtaining frontage consents. The fight between the General Electric Street Railway company and the Chicago City Railway company is now practically concluded, and the contending parties are awaiting the decision. The General Electric Street Railway company's attorneys say they are seeking to prevent by injunction the City Railway company from harassing it by suits of various kinds, which, it is averred, were instigated by the old South Side company.

TELEPHONE.

J. H. Janson contemplates forming a company and putting in a telephone exchange at Washburn, Wis.

The Northwestern Telephone Exchange company will probably build a line from Yankton, S. D., to Utica, S. D.

The Willmar Telephone company is erecting poles and stringing wires at Willmar, Minn., as fast as possible. The Northwestern Telephone Exchange company has appealed from the decision of the commission appointed to assess damages to land owners, and, unless the decision is radically changed, its line will not touch Willmar, but will end at Litchfield.

W. E. Stanley will conduct the Sunday School in the First Methodist Episcopal church in Wichita, Kansas, next Sunday, by telephone from his residence in the suburbs, a mile and a half from the church. Mr. Stanley has been superintendent of the Sunday School continuously for 21 years, but was thrown from a buggy, which incapacitated him from attending to his Sunday School.

TELEGRAPH.

Judge Sanborn of the United States Circuit Court at Topeka, Kansas, has issued an order requiring the expenditure of $27,000 by the receiver of the Union Pacific Railway company in repairing the Western Union lines along that road, and also an order requiring anyone who has any objections to the Postal company having the right to use the wires along the Union Pacific to appear before him and show cause why it should not.

The Western Union Telegraph company filed a petition in the United States Circuit Court at Omaha, August 17th, asking that W. D. Cornish, as special master, be granted an extension of time until October 15th, in which to complete the arangements for the segregation of that company and the Union Pacific Railroad company. The petition says the contract between the companies is of such long standing, and that it requires so much time and hard work to thoroughly investigate and arrive at conclusions, that it would be impossible to make the change by September 1st, as ordered.

The Postal Telegraph-cable company has filed with the State Railroad Commision of Tennessee a complaint against the Mobile and Ohio Railroad company, alleging discrimination in favor of the Western Union Telegraph company. The Postal company charges that the railroad company is distributing telegraph poles along its lines for the Western Union company and refuses to distribute poles along the line for the Postal Telegraph company, which is desirous of building a telegraph line along the road. The complaint also alleged that the railroad company's action is based on a contract with the Western Union.

MISCELLANEOUS.

The Penny-in-the-Slot Electric Supply company, with a capital of $250,000, of which $100,000 is reserved for working capital, has been incorporated in England. Its object is "to develop a slot electric meter and to work on the free wiring lines."

Sealed proposals for furnishing and delivering to the government of New York city oil engines, rotary transformers and storage batteries will be received until September 6, 1897. Information will be furnished upon application to Major John G. D. Knight, Willets Point, N. Y.

Dr. Cornelius Herz of Panama Canal fame has filed a claim with the State Department for damages against the government of France for illegal arrest and detention in England. After a careful examination of the papers in the case, however, the government declined to prosecute the claim, and has so informed Dr. Herz's counsel.

All manufacturers are requested to mail one of their more recent catalogues to the American Catalogue Bureau, Cleveland, Ohio. It is the intention of this bureau to open free business libraries in several of the more important cities of this country and abroad. By complying with this request manufacturers will not only benefit themselves, but assist in imparting some valuable information.

A safety brake invented by John Schuman, a poor machinist of Pittsburg, Pa., was tested recently on the line of the Pittsburg and Birmingham Traction company. By a small lever the motorman may lift the car off the rails, it is claimed. The shoe is in the form of a wheel, and when applied forms a sort of sled on the track, bearing the weight of the car. A car running at full speed was stopped within a space of 25 feet by this device.

City Engineer Ellicott has awarded a contract for putting in 32 new electric lights in Monroe and Adams streets, between the river and Ashland avenue. The construction work went to James Lyman & Co. at their bid of $2,090. The Western Electric company was given the contract for furnishing the lamp posts at $1,280. The contract for furnishing the supplies for the fire-alarm and police telephone and signal systems, amounting to about $8,000, has been divided between the Western Electric company and the Central Electric company.

The annual reports of the secretary and treasurer of the National Association of Gas and Electric Fixture Dealers, just issued in pamphlet form and covering the year ended on June 30th last, show that the membership has more than doubled during the year and now represents 26 states. The officers are: President, L. B. Cross, Kansas City, Mo.; vice-president, W. E. Goodman, Milwaukee, Wis.; secretary, Francis Almy, Buffalo, N. Y.; treasurer, John Kelly, Pittsburg, Pa. E. Baggot of Chicago is a member of the executive committee, and the state vice-president for Illinois is R. Williamson of Chicago.

A Washington dispatch relates that United States Treasurer Ellis H. Roberts has prepared a plan for protecting the money vaults of Uncle Sam in the treasury building by modern electrical devices. The plan has been approved by Secretary Gage, and contracts will be let in a few days for doing the work. If the system works satisfactorily, it will be extended to the other bureaus of the department, where money and valuable stamps are largely handled. The system provides for a central station outside the treasury building, as well as for stations within. These stations are on the same order as an alarm in a fire engine house. The different safes and vaults will be connected with these stations. In case a vault or safe is tampered with an alarm is immediately rung in at the stations. Should the stations in the treasury building be tampered with to prevent the proper alarms there, the central station would be sure to furnish the location of the evil work. The man in charge of the central station would immediately notify those inside. Treasurer Roberts will have an arrangement by which he can at once be notified at his home if anything wrong is going on. By the electric system the safes and vaults close at a certain hour, and if an attempt is made to open them previous to the hour fixed by the system for their being opened, the alarm is turned in.

TECHNICAL SCHOOLS.

By reason of the partial failure of its revenues, Lehigh University was forced to appeal to the state of Pennsylvania for aid. In response a grant of $150,000 was made for maintenance and general expenses. Thus, the present financial crisis has been tided over, and the work of the institution is uninterrupted.

Upon the retirement of Prof. H. W. Harding, professor of physics and electrical engineering at Lehigh University, he was presented a loving-cup, suitably inscribed, by the members of the faculty. Prof. Harding has a record of 25 years of active service, and the trustees made him emeritus professor of physics on his retirement. His successor, Prof. W. S. Franklin, late of the Iowa State College, is a young man who has already made a reputation for himself as a teacher, investigator and author.

The Society for the Promotion of Engineering Education held its annual session in Toronto early in the week. There were about 50 members present. The president, Dr. Henry Eddy of the University of Minnesota, in his opening address, spoke of the development of engineering and the advancement of the profession to a standing equal to that of law or medicine. W. H. P. Creighton of Purdue University, Lafayette, Ind., read a comprehensive paper on methods of teaching, and J. J. Flather of the same place contributed one on the teaching of machine design.

Charles H. Manning has prepared a favorable report of the Lawrence Scientific School of Harvard University. Better buildings have been provided; its equipment has been greatly improved; it is now well supplied with the best modern apparatus; the number of instructors has been increased to 16, and the students in its classes reached 146. A course in mechanical engineering was established four years ago, and the courses in civil and electrical engineering were remodeled, and all of them were arranged as regular four-year courses. Under the head of engineering there are 44 subjects of study for the members of the classes. The Rogers building has been fitted up for engineering experiments and tests of a general nature. The lower floor is for machinery, and two floors, put in for lecturing and drafting purposes, are occupied by advanced students.

ELECTRICAL SECURITIES.

The Cicero Water, Gas and Electric Light company of Chicago has declared a semi-annual dividend of one per cent.

Announcement is made that Mr. Yerkes has obtained control of the Metropolitan Traction company, which has leased the General Electric Railway company, and through these franchises proposes to establish connections on the South Side, which for years he has been negotiating with the Chicago City Railway company in vain. All state-

ments concerning the Metropolitan and General Electric companies are regarded with distrust by those who are acquainted with the history of these enterprises.

The gross earnings of the Brooklyn City and Newtown Railroad company for the quarter ended June 30th were $135,048, a decrease of $7,115 as compared with last year. The operating expenses were $70,981, the fixed charges $32,780, and the surplus $33,164, an increase in the net income of $2,895.

The Coney Island and Brooklyn Railroad company's gross earnings during the quarter ended June 30th were $90,801, a falling off of $6,913 as compared with 1896. The operating expenses were also decreased, but only $3,613, leaving the net earnings $31,105. The fixed charges were $14,869.

The Central Union Telephone company of Chicago is said to have placed $500,000 of bonds, the proceeds of which will be used in the work of construction now going on. The company proposes to erect 4,000 miles of copper wire telephone lines between cities and towns in which it has exchanges.

During the quarter which ended on June 30th the Nassau Electric Railway company of Brooklyn reports its gross earnings as $507,070, an increase of $41,819 over the corresponding period of 1896. The operating expenses were $279,424, fixed charges $182,866, leaving a surplus of $45,437, as against $22,052 in 1896.

The Edison Electric Illuminating company of New York reported gross earnings for July of $162,-453, an increase of $5,562 as compared with the same month of last year, and net $59,034, an increase of $1,767. For the seven months ended July 31st the gross earnings were $1,391,219, an increase of $128,423 as compared with the corresponding period of last year, and net $630,749, an increase of $88,943.

The report of the Edison Electric Illuminating company of Brooklyn for July contains the following items of interest: Gross earnings, $65,688, an increase of $8,062; net, $26,765, an increase of $4,018; taxes, $3,000, a decrease of $1,000; balance, $23,765, an increase of $5,018; other sources, $1,200, a decrease of $192; net result, $24,965, an increase of $4,826. The report for seven months ended July 31st includes the following: Gross earnings, $488,-896, an increase of $37,085; net, $219,213, an increase of $24,559; taxes, $23,200, a decrease of $4 800; net earnings, $196,013, an increase of $29,359; other sources, $7,730, a decrease of $2,888; net result, $203,743, an increase of $26,471.

An advance of several points in North Chicago securities during the week served to revive the story of a possible increase in the capital stock. At the last annual meeting Mr. Yerkes observed that he thought it would be not an unwise move to double the North Chicago stock. The latter now stands at $6,600,000, and rumor suggests the intention of the financial sponsors of the company to double this, making it $13,200,000. It was figured that the company could easily pay seven per cent. dividends on the doubled capitalization instead of the 12 per cent. paid now, and that the expansion would be a good thing for the shareholder, as it would increase his income and pave the way for the listing of the stock on the New York Stock Exchange.

During the last week there has been considerable interest shown in electrical securities both in New York and Chicago. In the local market the feature has been the strength and activity in South Side "L" and Metropolitan "L." Those who claim to have some information concerning the plan on which the Metropolitan will be reorganized say the bond issue will be cut in half and the stock will be assessed but $7 per share, five per cent. preferred stock to be issued to the amount that the bonds are scaled. This would give the holder of a $1,000 bond, which is now selling at $500, a $500 bond and five $100 shares of preferred stock, which should be worth $20 a share at least, if the common stock is worth $7, with a $7 assessment in prospect. Lake Street "L" started higher but fell back.

The rapid rise in the price of Central Union Telephone stock is explained by the fact that a pool of moneyed men was formed some time ago to gather in all the loosely held stock to be had, and employed brokers to canvass among the small owners of the shares, who are scattered all over Illinois, Indiana, Ohio, Iowa and Wisconsin. The recent sudden jump of 12 points in the value of stock came when the news of the operation of the pool leaked out, through comparison of notes by stockholders who had been asked to sell. The advance has given rise to a report that the company contemplated the early declaration of a dividend. The policy of the company for the present year has already been mapped out, and, it is said, no dividend will be paid in 1897. The company earned on its stock last year 3.6 per cent., and business has far in 1897 shows some improvement. The management is conservative and paid but one per cent. last year. With a revival of business the stock will be worth more than 50, it is believed, and it is quite probable that the regular five per cent. dividend may be resumed in 1898.

On August 12th the listing committee of the Stock Exchange of New York recommended the listing of the securities of the West Chicago Street Railroad company, including $3,969,000 first mortgage bonds, $6,031,000 consolidated mortgage bonds, and $13,189,000 capital stock. It was shown that the company had paid five per cent. dividends in 1888, 1889 and 1890, six per cent. in 1891, 6¼ per cent. in 1892, nine per cent. in 1893 and 1894, and six per cent. in 1895, 1896 and the first half of the present year. The comparative statement for the first five months of 1896 and 1897 showed a considerable falling off of receipts, but there was a corresponding reduction in operating expenses. The receipts were $1,651,642.52 in 1896, and only $1,511,-232.84 this year, while the operating expenses were $1,665,028.10 in 1896 and $923,526.32 this year. The net profit, therefore, this year is greater than last. According to the statement made by the company to the listing committee, it has 2,000 cars, 300 horses and 83 miles of double track of electrical construction. The general balance sheet of the road also submitted gives the cost of road equipment, right-of-way and construction as $16,331,184.52, while the cash on hand or in banks is $1,805,052.87.

TRADE NEWS.

The Central Electric company has just issued a very comprehensive catalogue of Hill switches, embracing the full line of these standard goods, which will be sent on application to any address. There are a number of new switches described.

The Law Battery company has been leased by the Gordon-Burnham Battery company, and all goods manufactured by either company can hereafter be obtained direct from the office of the latter at 82 to 86 West Broadway, New York city.

The New York offices of the Western Electric company have been removed to the new building of the company at 57-67 Bethune street, near West street, where a store for the sale of electrical goods has been opened. The store in the Thames street building is retained.

William H. McKinlock has notified customers of the Metropolitan Electric company, which recently made an assignment, that, in sending their orders, if the stock of the company is not complete enough to meet the demand, he will fill the remaining portion of such orders without delay and at satisfactory prices. Mr. McKinlock adds: "We desire to retain your trade and hope that within a short time we may effect a settlement whereby the Metropolitan Electric company may go on with its business as heretofore."

General Manager G. L. McDonald of the Electric Supply company of Memphis, Tenn., was a visitor in New York for several days last week. His trip was devoted entirely to business, and he reports that the outlook for the electrical trade in the vicinity of Memphis is better than it has been for several years, and that his company will carry a larger stock than it has ever done before, in order to meet this demand.

The Consolidated Car-heating company of Albany says: "On August 2d Judge Wheeler of the United States Circuit Court for the Second Circuit rendered a decision in favor of the defendant in the case of the Burton Electric company against the Union railway of New York, which was defended by the Consolidated Car-heating company. This decision settles the right of the Consolidated company to use the multiple series system of wiring with its electric heaters, and is a decided victory."

Many of the residents of Warren, O., participated in a great picnic held a short time ago at Conneaut Lake. The train was run in three sections, and it is estimated that 2,500 people enjoyed the outing. One notable feature is thus described by the Warren Daily Chronicle: "The most conspicuous train was the second section, which had three coaches set apart for the Warren Electric and Specialty company. Long banners in bold-faced letters were attached to the sides of these cars, bearing the inscriptions: 'The Warren Electric and Specialty company—Manufacturers of Anti-Trust Incandescent Lamps.' The company closed down its large factory in every department, despite the fact that the concern is rushed with orders, and took a day off. The entire force of employes and some outside friends, to the number of 150, went to Conneaut Lake as the guests of the Warren Electric and Specialty company. General Manager E. W. Gilmer was with the party, and saw that the orders for a thorough good time were fully observed."

BUSINESS.

The ninth catalogue of the enamel rheostats made by the Ward Leonard Electric company of Hoboken, N. J., is complete and gives much valuable information about essential electrical apparatus. General and catalogue indexes add to the value of the pamphlet.

J. Holt Gates & Co. of 1323 Marquette building, Chicago, report a good business. The firm is the western agent for Walker, Wagner and Card machinery and apparatus, and has recently made many sales, including a 3,000 light alternator to the Maywood Electric Light company and an 800 kilowatt generator to the Memphis Street Railway company.

To W. B. McDonald, superintendent of the People's Light and Power company, Chicago, must be given the credit of producing an arc lamp hanger board made entirely of glass, having a glass back or support, as well as glass insulating knobs. The device is known as the McDonald glass hanger board. This board can always be relied upon as a perfect insulator, and always looks bright and clean. This specialty is placed on the market by the Electric Appliance company, Chicago, which will be glad to quote prices on application.

The Stromberg-Carlson Telephone Manufacturing company reports a large demand for its switchboard operator's instruments, consisting of transmitter and induction coil with adjustable swinging extension arm and watch-case receiver, and in many instances including hand or power generators. This company has recently made a material change in its receiver, cutting down the adjusting case and magnet holders, which reduces the weight about one-half and in no way affects the efficiency and durability. It claims that none of its receivers so far has become demagnetized.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued August 10, 1897.

587,693. Signal Receiving Apparatus. Walter F. Banks, Milford, Conn. Application filed October 1, 1896.

This device comprises a receiving magnet short-circuited when the apparatus is at rest, an armature for controlling the short-circuit, a magnet for controlling the armature, and a mechanical retarding device for governing the movement of the armature.

587,696. Apparatus for Electrolysis. Anthelme E. W. Boucher, Prilly, Switzerland. Application filed August 13, 1896.

The construction of this apparatus requires a positive plate of non-oxidizable material, two bars of oxidizable material supporting the plate, material adapted to insulate the bars from the electrolyte, two negative plates inclosing the non-oxidizable plate and insulated therefrom, each of the negative plates being perforated to permit of the passage of the electrolyte, and a hood adapted to inclose the plates to collect the gases arising therefrom.

587,698. Apparatus for Detecting Electrolysis of Underground Pipes and Locating Transmission Losses. Harold P. Brown, New York, N. Y. Application filed January 27, 1896.

Two high-reading voltmeters, a low-reading voltmeter and rail and pipe conductors, or their equivalents, are employed.

587,700. Telephone Booth. Eugene B. Cadwell, Jamestown, N. Y. Application filed October 22, 1896.

A telephone booth having sides with double walls distanced by wooden blocks and interposed sound-deadening material between the blocks and the walls.

587,720. Electric Railway System. Stephen D. Field, Stockbridge, Mass. Application filed November 21, 1891.

A slotted conduit embodying metal frames, insulators flexibly mounted on arms projecting from the frames, and a working conductor composed of magnetic metal flexibly suspended from the insulators, are combined in this arrangement.

587,738. Trolley Truck. Thomas M. Kenna, New Haven, Conn. Application filed May 16, 1896.

The usual electric railway equipment is applied to trucks, and an arm is provided having a trolley wheel at one end and being pivotally connected at the other end to the end of the pole, and adapted to fold into the recessed part when not in use.

587,747. Igniter for Explosive Engines. Philip Mueller, Decatur, Ill. Application filed December 18, 1896.

A plurality of brushes communicating each with sparkers, a movable electrode adapted to contact with the brushes successively, a short-circuit for the current passing from the electrode to the brushes, or the reverse, and means for maintaining the short-circuit while the electrode is out of contact with a brush, and for breaking it when contact is made.

587,750. Electric Arc Lamp. James McLaughlin, Chicago, Ill. Application filed August 26, 1895.

An arc-establishing magnet or solenoid in a derived circuit about the arc is movable, and adapted to close the cut-out circuit, and in so doing include its coils in the cut-out circuit, and a shunt magnet or solenoid is connected mechanically with the arc-establishing magnet, the former raising the latter to close the cut-out circuit, whereby the coils of the arc-establishing magnet provide a resistance in the cut-out circuit.

587,752. Electric Railway Switch. Matthew J. M. O'Hara, Wilmington, Mass. Application filed March 27, 1897.

In addition to the railway main line and branch line there are a horizontal pivot, on which the switch tongue is movable vertically to connect and disconnect the main line and the branch line, a normally open electric circuit, an electro-magnet, a lever provided with an armature adapted to be attracted by the magnet when the circuit is closed to raise the tongue.

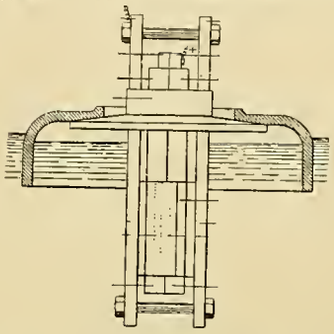
587,764. Wire for Armature Windings. Sidney H. Short, Cleveland, O. Application filed March 19, 1896.

A conductor for use in winding armatures and similar appliances comprising a plurality of wires, the adjacent contact surfaces of which conform in cross-section to the interstices between such wires, and thereby fill such interstices.

587,765. Armature for Dynamo-electric Machines. Sidney H. Short, Cleveland, O. Application filed March 29, 1897.

A plate or lamination for armature cores is described, having the ends beveled to lines radial to the armature center, the outer edge curved to the circumference of a circle struck from the center of the armature, and the inner edge straight.

587,769. Electric Motor. Julius L. Thoma, Kansas City, Mo. Application filed August 17, 1896.



NO. 587,696.

This motor comprises a circular casing, a top plate provided with a series of insulated holes or openings; a shaft is journaled in the bottom of the casing and in the top plate; a circular series of field coils is suspended from the top plate within the casing and having their upper ends extending through the insulated holes or openings; a commutator is mounted upon the top plate, surrounds the shaft and is provided with a series of pins which are connected to the ends of the field coils; a conducting annulus in the bottom of the casing is electrically connected to the opposite ends of the field coils; a conductor from the source of supply is connected to the annulus and extends through the casing; an armature is mounted rigidly upon the shaft within the casing and below the field coils; an armature is mounted upon the shaft above the commutator, and is provided with depending pins having their lower ends contiguous to the upper ends of the field coils, studs depending also from the armatures, brushes carried thereby and engaging the commutator, a collector at the upper side of the armature, and a collecting brush engaging the same and electrically connected to the source of electrical supply.

587,770. Apparatus for Causing Chemical Changes in Gases. Nicolaas van der Sleen and August Schneller, Alfen-Oudshoorn, Netherlands. Application filed January 18, 1895. Patented in Germany November 30, 1894; in England December 1, 1894; in Belgium December 29, 1894; in Italy December 29, 1894; in Switzerland December 29, 1894; in Luxemburg December 29, 1894; in Sweden December 29, 1894; in Norway December 29, 1894; in France December 29, 1894; in Spain March 30, 1895, and in Austria September 30, 1895.

Two or more electrical discharging apparatuses are employed, containing each a number of separated electrodes of the same polarity connected each to a separate specific resistance and electrodes of the other polarity, while cooling devices are arranged so as to alternate with the electrical discharging apparatuses.

587,782. Electro-depositing Device. John Bossard, Dubuque, Iowa. Application filed June 1, 1896.

A supporting device is mounted above the tank, with suspension hooks hung upon it, and means secured to the supporting device for advancing the articles through the bath, and suitable anode and cathode connections.

587,792. Electric Railway. Robert L. Caldwell, Cleveland, Ohio. Application filed January 21, 1897.

A connecting member for a main and a branch connecting wire consists of a straight leg adapted to be connected to the main wire, with its lower edge in the plane of the lower surface of the main wire; a diverging branch leg is adapted to be connected with the branch wire, and having its lower edge inclined downward from both ends below the plane of the lower edge of the main leg, and a depending wing on the lower edge of the main leg near the open end of the connecting member.

587,798. Electric Meter. Jean F. de Bauw, Brussels, Belgium. Application filed April 26, 1897. Patented in Belgium August 29, 1896.

A solenoid has a hollow core, through which passes a shunt current from the main current; an interrupter renders this current intermittent; one end of a soft-iron armature enters the hollow center of the bobbin; a flexible rod is suitably supported and attached to the other end of the armature, and a spring-pawl is fixed to the flexible rod; a ratchet wheel is engaged by the pawl; a shaft carries the ratchet wheel; a spring controls the shaft, the entire arrangement being such that the passage of the current in the bobbin produces a to-and-fro movement of the armature and of the flexible rod, whose pawl each time the armature is attracted by the bobbin causes the ratchet wheel to partly rotate, thereby producing a proportionate tension in the spring coiled around the shaft.

587,805. Trolley Hanger. Theodore Fletcher, St. Louis, Mo. Application filed October 10, 1896.

A suspension device for trolley wires consists of an insulating body having embedded therein a shank carrying a wire-supporting device, the body having a recessed neck, and protecting half collars surrounding the neck and adapted to receive the suspension wires.

587,818. Lightning Arrester. Edward M. Hewlett, Schenectady, N. Y. Application filed March 16, 1897.

There is the combination of arcing electrodes, a non-inductive resistance in circuit with one of the electrodes, and a blow-out magnet having the ends of its coil or coils connected to the non-inductive resistance at points between which there is a difference in potential due to the dynamo current following a lightning discharge.

587,838. Circuit Breaker. Hermann Lemp, Lynn, Mass. Application filed April 3, 1897.

This is a contact device for induction coils, comprising a pair of fixed terminals, a bridge normally held in contact with the fixed terminals by a spring, and a rheotome hammer for opening the contacts.

587,868. Commutator and Lead. Sidney H. Short, Cleveland, Ohio. Application filed March 12, 1897.

A lead for connecting an armature inductor with its commutator bar is described, consisting of a plurarity of metallic ribbons riveted together and adapted to be connected at one end to a commutator bar, and at the other end to an armature inductor.

587,869. Field Magnet for Dynamo-electric Machines. Sidney H. Short, Cleveland, Ohio. Application filed March 12, 1897.

Field magnets for dynamo-electric machinery are composed of a plurality of solid magnet cores, each having one end furcated by intersecting slots, combined with a yoke cast about the furcated ends of the magnet cores.

587,870. Trolley. Sidney H. Short, Cleveland, Ohio. Application filed February 16, 1897.

In a trolley there is claimed the combination of the trolley arm, its forks and fork ends, and a shaft which extends between and is secured to the fork ends, with a tubular roller surrounding the shaft, bearing pieces fitted and secured in the ends thereof, which bearing pieces are circumferentially grooved, an oil duct through each bearing piece to the groove, and an oil duct through the grooved part to the shaft, and bent springs secured to the fork ends and extended between the same and the roller.

587,871. Armature. Sidney H. Short, Cleveland, Ohio. Application filed March 13, 1897.

An end ring at each end of the slotted core having peripheries adapted to support the armature inductors beyond the core, insulating covering surrounding the peripheries and protecting the inductors from them, and troughs of insulating material in the core slots, the troughs projecting beyond the core.

587,883. Device for Examining Jewels by Röntgen Rays. Elihu Thomson, Swampscott, Mass. Application filed September 4, 1896.

The apparatus described for facilitating the examination of jewels by Röntgen rays consists of means for producing the rays, a support for the jewel opaque to light but transparent to the Röntgen rays, a fluorescent screen for converting the Röntgen rays into light after the passage through the jewel, a mirror for reflecting the rays, and eye-pieces for examining the reflected image.

587,921. Apparatus for Generating Constant Electric Currents. Charles N. Black, New Haven, Conn. Application filed April 26, 1897.

A directly connected constant current dynamo, with its working or distributing circuits connected in series with and between its independent armature circuits, translating devices located in the working or distributing circuits and arranged in series, has an automatic steam cut-off arranged to act when the same exceeds its rated speed.

587,931. Burglar Alarm. Clyde Coleman, Chicago, Ill. Application filed January 11, 1897.

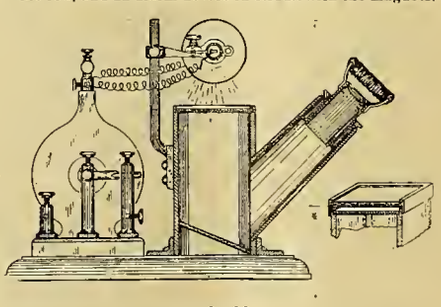
In an electrical barrier there is the combination with a plurality of parallel insulating strips, of a plurality of parallel conducting strips secured to the insulating strips and arranged so as to overlap.

587,937. Regulating Electric Motors. Albert G. Davis, Washington, D. C. Application filed November 17, 1896.

The method of increasing the torque of a tandem motor system consists in neutralizing by a phase-advancing device part or all of the lag of the intermediate circuit or circuits.

587,998. Electro-pneumatic Alarm. George W. MacKenzie, Beaver, Pa. Application filed April 15, 1897.

Electro-magnets are placed in proximity to the supporting rod for attracting the rod magnetically when the magnets are energized by a current established by contact with the rod, and an alarm device in circuit with the magnets.



NO. 587,883.

588,012. Process of and Apparatus for Making Metallic Carbides. Isaiah L. Roberts, Brooklyn, N. Y. Application filed September 14, 1896.

The process of continuously forming metallic carbides consists in moving beneath a horizontal electric arc the metallic compound and carbon to be converted, and in reflecting the heat of the arc downward.

588,021. Means for Controlling Electric Motors. Sidney H. Short, Cleveland, Ohio. Application filed May 17, 1896.

The combination is claimed with a driving electric motor, of a controlling electric motor, a fluid brake connected with the armature of the controlling motor, a valve for controlling the fluid brake, whereby to vary the load on the armature of the controlling motor, and a switch connected with the valve for short-circuiting the controlling motor.

588,035. Electrolytic Apparatus. William Thum, Newark, N. J. Application filed October 8, 1896.

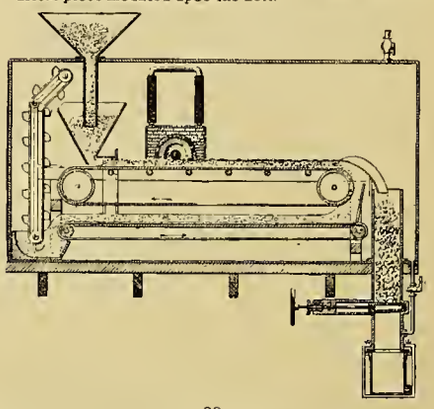
A cathode sheet is secured upon the inclined bottom of the tank, and anode cells are adjustably supported within the tank and provided with an inclined perforate bottom parallel to the inclined cathode sheet.

588,046. Printing Telegraph. Emile M. D. André, Méru, France. Application filed October 1, 1896.

This instrument comprises a key disk and type disk, both revolving in unison, a switch and stop lever of conducting material pivoted on a bracket lying beneath the key disk and movable on its pivot in a horizontal transverse line, a spring-driven train of gears, and electrically controlled means for releasing the gears.

588,048. Insulator for Wires. George Ashby, Hamilton, Canada. Application filed December 24, 1896.

An insulator is formed of a stem provided with an arm having a lug, a bolt connected with the stem, and a cylindrical piece mounted upon the bolt.



NO. 588,012.

588,053. Overhead Trolley System for Electric Railways. Solomon H. Cauffiel, Johnstown, Pa. Application filed July 24, 1896.

A crossing structure for conducting wires and trolleys, comprising intersecting arms having rails, part of the rails having pivoted self-sustained bars, one of which forms part of the support for a trolley, while another is raised by the inclined pole of the trolley.

588,084. Process of and Apparatus for Electro-chemical Treatment of Straw or Other Fibrous Materials. Goldsbury H. Pond, Ashburnham, Mass. Application filed September 15, 1896.

The method described consists in packing or banking the straw in a tank containing a solution of chloride of sodium in such manner that an open cell or space is formed between the anode and the mass of straw, and then causing the solution to be circulated in the vat and subjected to the action of an electric current.

588,085. Method of and Apparatus for Electro-chemical Treatment of Fibrous Material. Goldsbury H. Pond, Ashburnham, Mass. Application filed February 12, 1897.

One feature of the method described consists in decomposing the chloride of sodium solution in separate cells formed on each side of the material being treated, and drawing the resultant parts of the decomposition of the salt from either cell in the proportions desired, and circulating the same through the material.

588,097. Electric Railway System. Louis E. Walkins, Springfield, Mass. Application filed April 15, 1897.

One claim is given: In an electric switch mechanism, in combination, a part movably mounted and adapted to be operated by a passing object as a wheel of a car, two pairs of electric terminals or contacts for different circuits, and two switches movable to connect and disconnect the contacts of both pairs, a switch-operating part receiving movement from said wheel-operated part, and connections between it and both said switches actuated by said switch-operating part, whereby both switches are simultaneously operated, an armature arranged to normally engage said switch-operating part, and an electro-magnet adjacent the armature.

588,101. Electrically Operated Loom. Edwin D. Chaplin, Cambridge, and Henry G. Halloran, Boston, Mass. Application filed July 16, 1896.

One claim is for an electro-field magnet, an armature reciprocable exterior to the coils thereof but intersecting the lines of force of the magnetic field, a shuttle-carrier connected with the armature to move therewith, a shuttle mounted on the carrier, means to produce a current in the field magnet and armature, and means to reverse the current of one of them at each stroke of the armature.

588,104. Electric Locomotive. Rudolf Eickemeyer, Yonkers, N. Y. Application filed May 9, 1892.

An electric motor having field coils divided into sets or sections, in combination with shunt resistances, each separately connected with the terminals of appropriate field coil sections.

588,105. Electric Locomotive. Rudolf Eickemeyer, Yonkers, N. Y. Application filed August 23, 1892.

An axle, a motor separate therefrom, gearing between the motor and the axle, a link hinged or articulated with both the axle and the motor constituting a housing for the gearing, and another arm extending from the axle to the motor.

588,106. Elevator Controller Lock. William C. Fahy, Philadelphia, Pa. Application filed April 4, 1896.

There is the combination of a sliding door, a lever hung in front of the door, mechanism yieldingly actuating the lever in one direction, the lever having its free end curved in the direction opposite that toward which it is impelled by the mechanism, a guide for the lever, a part connected with the starting mechanism, locking device engaging with the part, and connections between the locking device and the lever.

588,111. Current Collecting Device for Electric Railways. Rudolph M. Hunter, Philadelphia, Pa. Application filed February 4, 1897.

A support is jointed to the car at the bottom, and has a guide at the top adapted to travel along the under side of the suspended conductor, combined with a current-collecting roller journaled upon an upright axis and arranged close to the side of the guide and electrically insulated from it, whereby the contact is made with the conductor immediately in the vicinity of the guide.

Western Electrician.

EVERY SATURDAY.

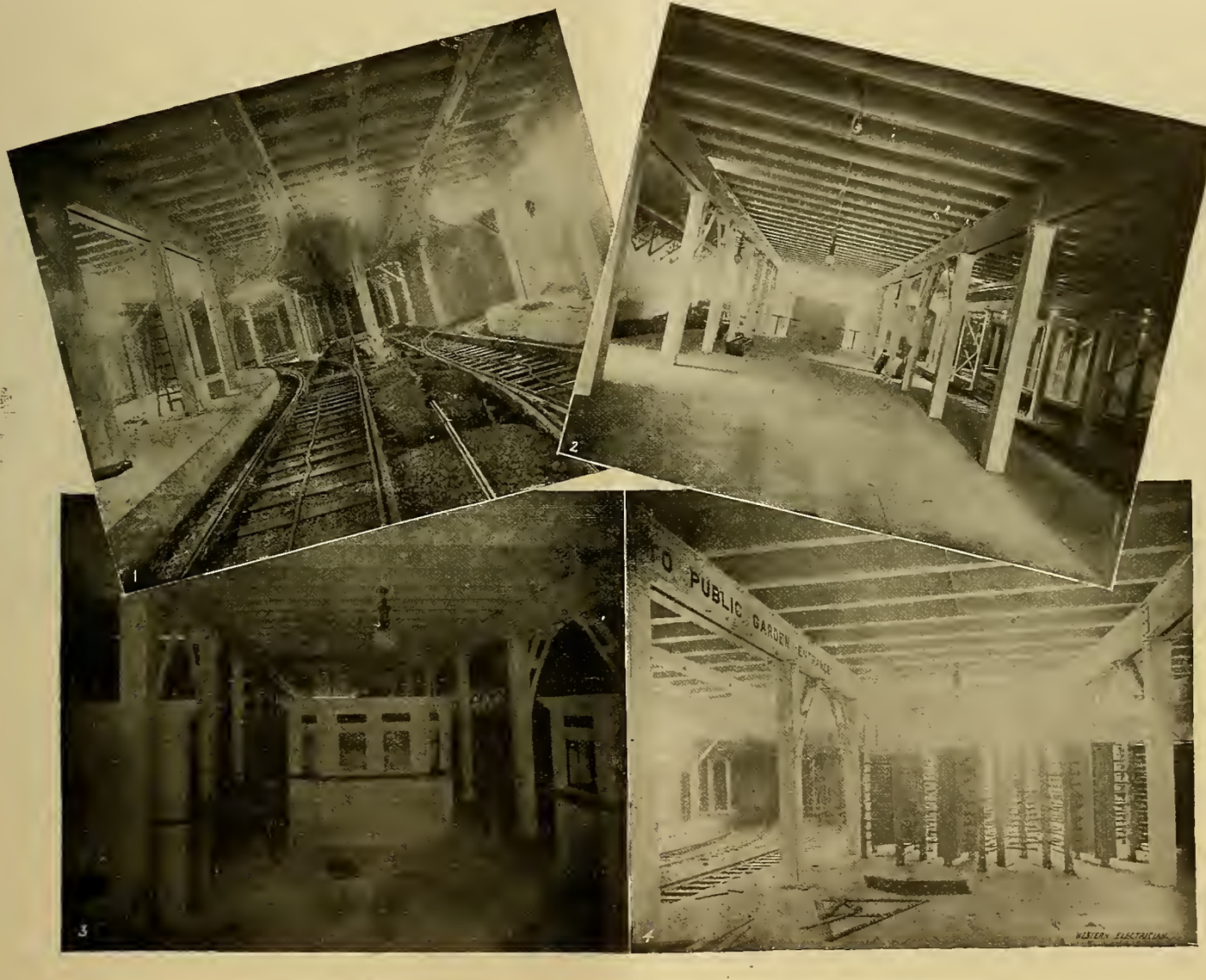
Vol. XXI. CHICAGO, AUGUST 28, 1897. No. 9

The Boston Subway.

Three of the 12 sections of the subway in Boston will be entirely completed by September 1st, and on that date 50 per cent. of the cars of the West End Street Railway company will be taken off of Tremont street and run through the subway. These will include the cars which run in town from the southern suburban districts of Boston and which are now turned at the head of Tremont street in front of the old Granary burying ground and sent out over the route by which they come. Of course the cars which would permit of no encroachment on the sacred soil of ancient Boston Common. The sentimentalists on this subject, and they included many of the most influential and powerful families in the city, were extremely bitter in their antagonism when the subway plan was first brought forward. It contemplated cutting up the common to some extent, and the defenders of this sacred spot turned out en masse to protect it. Many hearings were held before the legislative committee which had the subject of rapid transit under consideration. Letters appeared continuously in all of the Boston newspapers in relation proper authorities to provide a proper grade from a point where its tracks leave the surface line to the point where they are to connect with the subway system. It is probable that both of these sections will be equipped and cars running therein before the snow flies.

Sections 6 and 7, extending from Park street to Scollay square, together with sections still farther north, are also completed. Bids for section 11 will soon be advertised, the Transit Commission having already decided upon the form of the contract.

On the Tremont street mall of the common are



1. The Loop at the Park Street Station.
2. Boylston Street Station.
3. Typical Ticket Office.
4. Exit at Park Street Station.

THE BOSTON SUBWAY.

come in from the south and which go clear across the city to the Union station and those entering from the north will use the highways until the other sections of the subway are completed.

This subway is designed to solve the problem of rapid transit through the congested business district of the city. It will cost eventually something like $7,000,000. It is safe to say that there has not been a project of public improvement of the magnitude of the subway before attempted in the history of the city of Boston, and both before and after the passage of the Subway Act early in July, 1894, by the Massachusetts Legislature, there was a most persistent fight made by an element in the community which was hostile to the construction of a subway and which did not believe that it would accomplish that which the projectors claimed for it. In addition to the objections which the friends of the subway had to meet from those who were hostile to it from a purely business point of view, they had also to contend against a public sentiment which to the subject, but finally the friends of the scheme succeeded in stifling the opposition, and the Subway Act became a law. The opposition was revived soon after the passage of the act, however, and the last round of the battle took place in the Supreme Court. On June 15, 1896, the Supreme Court decided that the Subway Act was constitutional.

The subway has been constructed under the direction of a commission of five men appointed by the governor, Hon. George G. Crocker being the chairman. The three sections of the subway which are to be opened for public travel on September 1st extend from the Public Garden entrance on Boylston street, opposite Church street, through Boylston and Tremont streets to Park street, where the loop occurs, thereby accommodating all Back Bay, Brookline, Allston, Brighton and cross-town cars. Sections 4 and 5 on Tremont street, south of Boylston street, are completed and have been ready for equipment for months, but the West End has delayed putting down the steel, owing to the failure of the the exterior glass-covered stations which will form the entrances to and exits from the subway. These are located every two or three blocks. Entering one of these, the sightseer gets a sweeping view of the broad stairway leading directly down to the depth below, and sees the network of tracks, trolley wires and subway equipment generally, stretching far away in the perspective. The interior of these subway stations is as light as day. Directly overhead is suspended a large arc light which brilliantly illumines the white enameled brick walls and throws daylight into every nook and crevice, as far as the eye can reach. A flight of some 30 iron steps, provided with a patent safety tread of corrugated lead, which makes slipping an impossibility, leads down to the subway platform. At each side a brass handrail runs the entire length of the stairway. On arriving at the foot of the stairs the traveler will find his "open sesame" to be a five-cent piece, which he will hand into the ticket office and will receive in exchange a ticket which will entitle him to a ride

and which will be taken up by the conductor on the car or train and registered as a regular fare. There are four of these ticket offices at every entrance, each of light pine wood. The central one is double and is flanked by two smaller ones. Between these ticket offices are four passages, each of which is just wide enough to admit one person at a time.

The subway platforms are of smooth and solid granolithic composition (artificial stone), and between the platforms are high barriers of netting, designed to keep people from crossing one track to another. The style of construction of all the exits and entrances is similar, the only difference being that, instead of having ticket offices, the exits are provided with big wooden turnstiles about eight feet high. There are eight of these turnstiles, set in an iron frame, at each of these exits. The West End company, acting under authority of the Transit Commission, is now preparing plans for swinging doors to be placed at the open ends of the station coverings.

Broken stone ballast is used, and for the section south of Park street over 10,000 tons are required. The ties on which the rails are laid are of chestnut, boiled in woodiline to exclude moisture. Sixteen ties are used to every 30 feet of track. The rail is the American Society of Civil Engineers' standard section of T-rail for steam railroad use, and weighs 85 pounds per yard. The rolled steel wheel guard on the inside of each rail, and bolted to the rail, weighs with bolts about 43 pounds to the yard, making the total weight of the rail and guard as bolted together 128 pounds. This guard has been adopted as a complete security against derailment. The joints and tie-plates are of special type, representing the most advanced methods of construction. The switches will be provided with moving rods similar in construction to those used on steam roads. The overhead construction, consisting of a wooden trough of cypress plank, thoroughly painted, is securely bolted to the roof of the subway, proper insulation being used. The trolley wire used is of figure 8 pattern, weighing 1.064 pounds per foot, and having an area of about 362,000 circular mils, or nearly 3½ times the size of the ordinary trolley wire. It is held in place by a specially designed clip and hanger provided with the necessary insulation.

At the stations the platforms will be lighted by arc lamps. Between stations incandescent lamps will be used, one about every 12 feet. Ventilating fans operated by electric motors are installed.

The West End company has a 20 years' lease of the subway, and the first spadeful of earth was removed in the presence of Gov. F. T. Greenhalge on March 28, 1895. On March 23, 1895, the contract for section 1 was awarded to Jones & Meehan, a firm of local contractors; the contract for section 2 was awarded to E. W. Everson, September 20, 1895, and the contract for section 3 was awarded to F. E. Shaw, October 21, 1895.

There has been but one accident during the course of the construction of these sections of the subway. On March 4, 1897, there was an explosion of gas between the planking and the roof of the subway at the corner of Tremont and Boylston streets, which resulted in the death of 10 persons and the injury of about 40 others. No blame was attached to either the subway commission or the contractors engaged in the work of building the structure.

A careful estimate made by the operating department of the road places the number of cars which will be run through the subway at 90 an hour, or a car every 45 seconds both ways.

Electrical Water Meter.

There has been so much complaint of theft of water from the mains of the city of Chicago that, at the request of Mr. McGann, commissioner of public works, Alexander Prussing has devised an electrical recording water meter intended to defeat the schemes of the dishonest. By the new method the dials register in the city hall and not on the individual meters. The clockwork, actuated by the passage of the water consumed through the service pipe, is removed and replaced by a simple pin, which moves with every revolution of the water wheel or every stroke of the piston and makes and breaks an electrical contact, thus registering with unfailing accuracy on the dial in the water office. An attempt to interfere with the operation of the device by short-circuiting would instantly give an alarm in the water office by causing a bell to ring and an indicator to record the number of the meter being operated upon. The same bell alarm system is used to prevent the meter from being opened, the removal of the cover infallibly breaking the circuit and setting the bell going.

The cost of installing this system would be great, but the inventor seems confident that it would pay.

Electric Plant at Shoreditch, England.

Lord Kelvin's advocacy of the plan adopted at Shoreditch, England, of burning garbage and utilizing the heat thus produced for the production of steam and electricity, has attracted the attention of many who are endeavoring to solve the same problem in American cities.

"It is only six weeks since the works were opened," Lord Kelvin is reported to have said in newspaper interviews, "but they have proved themselves to be a great success. Ten tons of 'dust' are equal, we calculate, to one ton of coal for steam making. Enough energy is now obtained to operate the municipal electric lighting plant, and so long as 'dust' is obtainable not an ounce of coal need be used. Whatever dust or refuse is collected has combustible qualities, and is therefore available." Shoreditch, he said, had hitherto paid two shillings three pence a ton to have the garbage carted away and emptied into the sea. Now, he said, he believed the city was in a fair way to get a revenue from the garbage instead of the great sum which it had cost to dispose of it. The slag, which is the final residue from the Shoreditch furnaces, he said, was to be used for road making.

There are several interesting features mentioned in a description of this plant in the London Electrical Review, from which the accompanying cuts are reproduced. Shoreditch has a large area and population. It is provided with 300 public-houses, numerous manufactories and warehouses, and altogether, is considered a splendid field for the sale of electric light and power. Of the plant itself, it may be said that the destructor house is 80 feet square, and contains 12 cells, each having 25 square feet grate area and six water-tube boilers, each with 1,300 square feet of heating surface. Halpin's thermal storage system is used, and electric lifts and motor cars are substituted for revising and distributing refuse throughout the cells, in place of the more usual inclined road and tipping platform. The boilers and thermal storage vessel, which is 35 feet long and eight feet in diameter, are designed to work at a pressure of 200 pounds per square inch, and are supplied with duplicate fittings throughout, to guard against breakdown. There are three motor-driven fans, calculated to deliver each 8,000 cubic feet of air per minute. The chimney is 150 feet high and seven feet internal diameter at the top, jacketed with firebrick throughout, and surrounded at the base with a centrifugal dust-separating chamber.

The gases from the cells pass out of each cell at the front, thence through the boiler tubes and out at the back of the boilers into either of the two main flues leading to the settling chambers and chimney.

Whenever required each boiler may be shut off, by means of dampers, entirely free from each or both, of its adjacent cells, and may also be fired at all times independently with coal or any other suitable fuel. Again, the cells may be worked independently of the boilers, but in this latter contingency the gases pass out from the cells at the back and not at the front. Owing to this arrangement, the cells may be repaired independently of the boilers, and the boilers may be repaired independently of the cells. Moreover, in the event of refuse not being collected or being deficient from any cause whatsoever, steam may still be raised by means of coal.

It is said to be possible for one man to keep the whole of the 12 cells charged at regular intervals, and, moreover, the refuse is never left to ferment or heat on hot brickwork or ironwork. It is always kept cool and thoroughly well ventilated by means of artificial draft provided by the fans.

Steam will be generated at all hours during the twenty-four, owing to the necessity of burning refuse continuously, and the working conditions are therefore essentially different from those prevailing in the ordinary coal-fired boiler house.

With the arrangements at Shoreditch, during the daytime, steam generated in the boilers is passed into a thermal storage cylinder, where it is mixed with a small quantity of cold water from the feed pumps, the proportions being such that when the evening approaches the cylinder is full of water at the temperature and pressure of the steam required by the engines. The cylinder is then shut off from the feed pumps and connected to the boilers, which, in their turn are connected direct to the engines, hence, when the boilers require feed-water, they are supplied with it from the cylinder at such a temperature that the fuel that is then being burnt has merely to furnish to the water in the boilers the heat sufficient to overcome the latent heat of evaporation at the required pressure. The result of this arrangement is that the boilers are able to evaporate about one-third more steam than they would be able to evaporate were they connected directly with the water mains, and, moreover, gases can be sent away from the boiler at such a low temperature that they would be useless for the purposes of even an economizer.

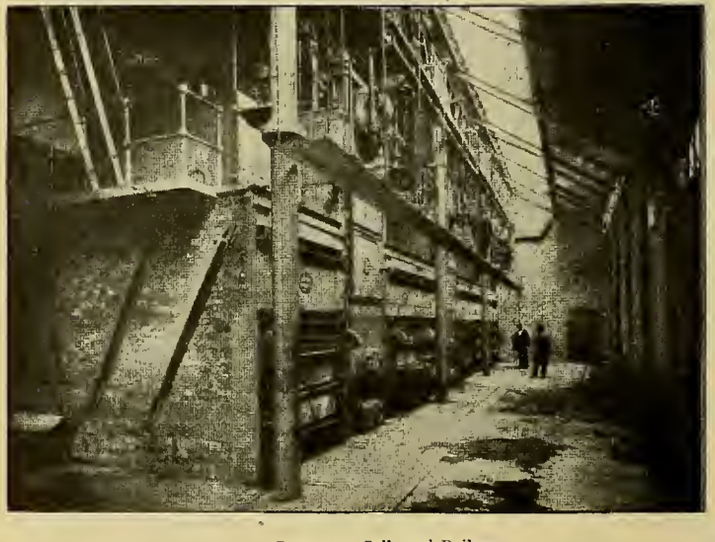
It is anticipated that the most efficient rate of working the destructor will be found to lie between eight and 12 tons per cell per diem. The combined arrangement of cells and boilers is designed so that when 10 cells and five boilers are at work, the average evaporation per hour from refuse only will about equal the average quantity of steam required by the engines throughout the whole of the 24 hours.

The system of lighting is that known as the Oxford, the generating station being near one portion of the low-tension network; a low-tension steam plant is also installed in the generating station as well as the high-tension continuous current plant for feeding the motor-transformer sub-station. The plants at present installed in the generating station consists of three generators coupled to Willans three-crank engines, each set having an output of 160 kilowatts at about 1,100 volts, and three low-tension dynamos coupled to Willans three-crank engines, each set having an output of 70 kilowatts at 165 volts. The speed of the larger sets is 350 revolutions per minute, and the speed of the smaller sets 460 revolutions per minute.

The Willans engines of both sizes have been specially arranged with automatic expansion gear, so that economical results and good governing are obtained when working at any pressure within the wide range of 200 pounds to 120 pounds to the square inch—this range of pressure being necessary in order to enable the thermal storage system to be utilized in connection with the scheme.

The armatures of the dynamos are of the drum type, with Eickemeyer coil winding. There is also installed in the generating station a volt-raising transformer capable of adding 75 volts to a current of 200 amperes. This transformer is used for adding the necessary volts to completely charge the set of accumulators.

A motor-generator is a feature of the generating station, having an output on either side of 60 kilowatts, and being used to enable either high-tension current to be produced from the low-tension generators, or low-tension current to be produced



Destructor Cells and Boilers.

Tipping Platform and Thermal Storage Cylinder.

ELECTRIC PLANT AT SHOREDITCH, ENGLAND.

from the high-tension generators. By this means, during light load times, when it may be economical only to run one set, either a high or low-tension generator current can still be produced of the other character. The main switchboards are divided into three sections, namely—high-tension board, low-tension board and arc-light board, each board being designed to permit of future extensions.

The public lighting consists of 57 standards, supporting arc lamps, replaced by incandescent lamps after midnight, and 36 incandescent lamps in side streets, burning all night.

The system of using arc lamps until midnight only, and replacing them after midnight with 32 candle power incandescent lamps, was recommended because of its success at Portsmouth. Owing to the economy thus effected in the consumption of current between midnight and dawn, larger arc lamps than those generally used, namely, 12½ amperes at 45 volts, will be employed. These lamps are arranged in circuits of 19 in each series, running off the high-tension bus-bars at a difference of potential of 1,000 volts.

The vestry has arranged for three sub-stations in the parish. Of these, the principal one is already finished and in operation. It consists of an underground room 22 feet 6½ inches by 17 feet, which has been constructed underneath a road refuge, from which access is had to the sub-station by a flight of stairs. In this sub-station are at present installed three motor-transformers with their automatic switches. The other two sub-stations are cottages, the basements of which will be fitted up to take similar motor-generators, the upper parts being let to the employes at the generating station as residences.

The battery of accumulators employed is capable of discharging at a rate of 170 amperes for six hours at least, and of maintaining a minimum electromotive force of 165 volts throughout the discharge. It is also to be capable of being discharged without injury to it at much higher rates, the maximum being 350 amperes. The capacity of the battery for a higher discharge rate than the normal is 272 amperes for three hours, the minimum electromotive force of 165 volts being maintained in all cases.

Lord Kelvin's American Visit.

Lord Kelvin has been the recipient of unusual honors and marked attention since his arrival in this country two weeks ago, and every facility has been afforded him of studying the examples of American engineering work, in which he is particularly interested. He announced on landing in New York that while he would read a paper at the Toronto meeting of the British Association for the Advancement of Science, his principal object in visiting America at this time was to observe and study American practice and note the advancement that had been made since his last visit, 13 years ago.

The first point of interest was the great electrical development at Niagara Falls. Lord Kelvin's views upon this project were communicated in an interview with the representative of the Western Electrician at Niagara Falls, which was published in the last issue of this journal. During his inspection of the great electrical plants at Niagara, Lord Kelvin was attended constantly by Dr. Coleman Sellers, who was pleased to reciprocate the attention which he himself had received from Lord Kelvin while abroad. W. B. Rankine also contributed largely to the enjoyment and comfort of the party. Dr. J. T. Bottomley, Lord Kelvin's nephew, who has charge of the laboratories at the Glasgow University, in which Lord Kelvin spends a great deal of his time, was an interested observer of the processes and products of the great electro-chemical works which the party visited. Lady Kelvin and Mrs. Bottomley were given an opportunity to enjoy the falls and the park with all their natural scenery. Before the visitors left the Falls a photograph was made of the group, of which the accompanying picture is a reproduction. Lord Kelvin was very much impressed by the character and extent of the work that has been undertaken at Niagara.

At Toronto Lord Kelvin was given a hearty welcome. On Friday, August 21st, he read an interesting paper upon the "Fuel Supply and the Air Supply of the World," which attracted considerable attention and led to much discussion and speculation. It was an interesting collection of facts and figures which, from the nature of the subject, could point to no definite conclusion. He had calculated the total present available supply of oxygen, exclusive of that in the sea, at 510 million million tons, and since it requires one ton of oxygen to consume one-third of a ton of fuel he reckoned that when 340 million million tons of fuel had been disposed of the fuel business would be come extinct. Taking this estimate as practically the total amount of fuel in the world, he found it provided 200,000 tons for each person alive to-day, which reasoning alone would bring the end of the human family appreciably near in the future. But nature appears to be taking care of the oxygen supply by restoring, through the output from vegetation, much of the ravages made by the combustion of fuel, so that after all Lord Kelvin's estimate permits man to breathe easier over the possible fate of his posterity.

Lord Kelvin, in company with Lord Lister, the retiring president of the British Association, and Sir John Evans, the present head of the organization, was honored by the Toronto University, which conferred upon him the degree of doctor of laws and enrolled him in the alumni of the university. Lord Kelvin was tendered several receptions during his stay in Toronto.

British Association Meeting.

Comparatively little attention was bestowed upon purely electrical subjects at the Toronto meeting of the British Association, rather to the surprise of those who who had anticipated an interesting session to consider some of recent developments. Several interesting papers were presented, however, and there was no lack of attention to these contributions. An enjoyable feature of the meeting was a trip to Niagara, where the members were given excellent oportunities to examine the power plants and study the developments that had been made during the last few years.

In a contribution on August 20th Prof. H. L. Callendar and L. N. Evans of McGill University, Montreal, reported that under certain conditions carefully dried and purified argon placed in an X-ray tube is absorbed with extreme rapidity, and with intense sputtering and heating of the cathode in a manner which suggests the formation of a very stable compound.

Prof. S. P. Thompson described experiments which help to explain some of the intricate phenomena of cathode rays. He said they seem to show that a molecular torrent of negatively electrified particles may be deflected by a magnet and by electrostatic force, and that the part of the emanations from the cathode which is not deflected by either influence is what may be called light, being most probably a wave motion of the ether.

In the evening discussion Lord Kelvin gave as his opinion that this proposition was supported by the experiments.

Wm. B. Rankine. Dr. Coleman Sellers. Dr. J. T. Bottomley.
Lady Kelvin. Lord Kelvin. Mrs. J. T. Bottomley.

LORD KELVIN'S AMERICAN VISIT.

Experiments with Fluorine Gas.

According to reports from Toronto, August 23d, fluorine gas was made for the first time in America during the meeting on that day of the British Association for the Advancement of Science. It was a portion of the chemical section's programme of interesting demonstrations, and its announcement attracted the majority of the distinguished thinkers. The feat was accomplished by Professor Meslans, head assistant to the famous Professor Moissan of Paris, whose researches with fluorine have been one of the features of the recent chemical progress of the world. Professor Meslans journeyed all the way to Canada to make the demonstration and succeeded most admirably. His running talk, which accompanied the experiment, was in French and was merely a description of the apparatus and method employed. Professor Meslans' apparatus consisted of a bucket filled with snow and salt, in which was immersed a U-shaped tube containing hydro fluoric acid. Two electric wires dipped into the liquid, and small copper tubes carried away the liberated gases. These tubes first ran into a small copper vessel which was filled with solidified carbonic acid and alcohol to keep the temperature sufficiently low to prevent the destruction of the apparatus. When Profesor Meslans had arranged everything to his satisfaction, the current was turned on and the gas began to form. Then a number of experiment were carried on, showing that the curious element attacked practically every substance presented to it, bursting into flame the moment it touched charcoal, silicon, alcohol, benzine, sulphur, potassium, iodide and many other substances.

Fuel and Air Supply of the World.

Lord Kelvin's address on the "Fuel and Air Supply of the World" was the feature of the meeting of the British Association for the Advancemen of Science. It was delivered at Toronto on August 20th and was received with marked attention. The discourse was largely an informal talk, much after the style of the college professor explaining the details of a problem for the benefit of a class in mathematics. The eminent scientist was very much interested in his subject and imparted much of his enthusiasm to his audience. In the course of his lecture he said:

"Three tons of oxygen are required to burn a ton of average coal. An average of three tons of oxygen emits in the formation of vegetable substance the same heat as a ton of coal or of some analogous fuel.

"I shall, for brevity, then, take as the standard fuel one that requires three tons of oxygen to burn it. We have a very short fuel supply of the world. It cannot be more than the total oxygen of the world. The total fuel of the world is equal to or less than the total oxygen in the air and sea.

"I do not reckon the oxygen in the sea, because the total amount in the whole depth of the sea is small in comparison with the oxygen in the atmosphere.

"Computed by the French metrical system, which seems to be confirmed in its simplicity by its natural relations to the varying systems of measurement throughout the world, we find that the weight of the atmosphere is 10 1-3 tons per square meter. What, then, is the total fuel of the world? What is its superior limit? Three tons of oxygen to each ton of fuel. Well, 510 million million tons of oxygen, and 340 million million tons of fuel, which is equal to or greater than the whole fuel in the earth, the fuel of all kinds, wood, grass and plants, at present on the surface and vegetable mold containing a certain amount of fuel.

"Now, there is something like 200 000 tons of fuel per capita of population, so that it is interesting to compare that with the population of the world and the use of fuel per inhabitant.

"Now, it is probable that England and Scotland

have more coal in them than they can burn, and if we were to pile the whole amount from Great Britain into a mass sky high and get all the coal out at once and burn it, the oxygen would be all consumed long before the coal would all be burned.

"After all, it is the want of oxygen rather than the want of coal that we must look forward to, unless—and now I come to the point—unless vegetation continues to do its work. The coal supply is the mere reservoir of a small part of the work done by sunlight in the 20 million years which I believe is the duration of vegetable or animal life in the world.

"I do not subscribe to the extreme view of 50 million years, but believe it is from 20 to 30 million years. Taking the amount of dry fine wood produced by the German forests, reduced to British acres and thence to square meters, it appears that two tons of fuel per square meter per thousand years is about the power of vegetation under the most favorable circumstances for producing fuel.

"It is curious that the German forest and the English hay field give very nearly the same amount.

"It seems to me that the problem for the agriturist and for mankind generally is improved agriculture, so that it will produce as much food as it produces now and twice or three times as much fuel material.

"Some people have called attention to the great possibilities contained in the vast water powers of the earth, but when we consider that the 120,000 horse power thus far developed at Niagara is only equal to four ocean liners, and that its 3,000,000 horse power is equal to 100 ocean liners, and then consider the water powers in other parts of the world, we still find that it is exceedingly small in comparison with all the wants of the earth.

"Therefore we conclude that as coal is burned vegetation must produce its equivalent, or else in a very few years we should lose the air and should die, not for want of coal, but for want of air to breathe."

Paterson's Crippled Electric Plant.

The accident to the power station of the Paterson Electric and Illuminating company described in the last issue of the Western Electrician, which plunged the city in darkness and caused a cessation of traffic, has been partially repaired, and the plant is again furnishing current for electric lighting, street railway and power purposes. The loss in traffic to the Paterson Railway company caused by the accident was at least $3,000, and that to the other two trolley lines about the same. The Edison company sustained a loss of about $25 000 or $30 000 on account of its failure to supply light and power, but under its contract it cannot be held for damages caused by the accident. In addition to the motive power furnished to the trolley lines in the city and vicinity, the Edison company supplies the power for 654 arc lights in the city and 134 throughout the county; 300 incandescent and 150 ordinary arc lights in stores are supplied, and 20,000 incandescent lamps in business places and private residences. There are 12,000 fans in operation throughout the city. Motors are used for running machinery as follows: Carpenter shops, 10; silk and rug manufacturers, 14; printing presses, 7; coffee mills, 9; exhaust fans, 3; machine shops, 4; elevators, 13; cutting machines, 11; pumps, 3; ice cream freezers, 12; butchers, 8; church organs, 3; repair shops, 12; jewelers, 3; miscellaneous, 20.

The inconvenience and annoyance caused by the breakdown were felt by residents of the city far more than any actual damage resulting from the accident.

Reminder of the Northwestern Meeting.

A somewhat belated photograph of the Northwestern picnickers, enjoying the hospitality of Col. Copeland of La Crosse, has just been received from the local artist who undertook to perpetuate the features of those who participated in that enjoyable gathering. It is here reproduced more for the purpose of assuring the gentlemen that they were really photographed than for any other purpose. No one has volunteered an explanation or excuse for the disappearance of the photographer, nor does there seem to be any reason why he should reappear at this particular time. At any rate, those who comprised the party will be glad to have a souvenir of the day which will recall the faces of the jolly crowd that participated in this excursion and the hospitable reception and entertainment accorded the visitors by Col. Copeland and those associated with him.

REMINDER OF THE NORTHWESTERN MEETING

Rescuing a Lineman.

Eugene Welch, a lineman employed by the Springfield, Mass., electric light company, received a severe shock while at work at the top of a 65 foot pole with two companions, Ralph Sanborn, a foreman, and Charles Allen, a lineman. The other two men were on the crosspiece above, drawing up another crosspiece, and Welch was on the "T" bar beneath, winding a wire. In some way his left shoulder hit a live wire, and his right hand coming in contact with the line he was winding, the current passed through his body. He gave a scream and became insensible, but the wires and the prompt action of his fellow linemen prevented him from falling to the pavement below. The men pulled him from the wires by main force and then their work was only begun. The problem was to get the insensible man to the ground, but the men accomplished the feat in safety, and by the time it was done people were beginning to realize something was the matter. After getting the man from the wires the linemen held the body and pulled up the crossbar. The rope was then put about the body of the insensible man, and Sanborn, supporting the body from beneath, slowly went down the pole, while Allen dealt out the rope from his lofty perch. It was a bit of prompt, level-headed work on the part of Welch's fellows, and to them in a way he owes his life.

Natural Scenery and Industrial Development.

Lord Kelvin surprised many of his admirers by his outspoken advocacy of the utilization of the water power at Niagara, even at the expense of the natural scenery, as related by the correspondent of the Western Electrician last week. He also touched upon the question of the water powers of Scotland and the possibilities of a revival of life and prosperity in the Highlands being brought about by taking advantage of these natural resources. Lord Kelvin had already expressed similar views before leaving Scotland, and it appears that his remarks were not received with unmixed pleasure. The occasion of this expression was the opening of the carbon works of the British Aluminum company at Greenock, when, referring to the electrical utilization of the Falls of Foyers, Lord Kelvin is reported to have said that the magnificent piece of work was the beginning of a scheme that would yet transform the whole social economy of districts like the Highlands of Scotland, where water abounded. He looked forward to the time when the Highlands would be repeopled to some extent, not by the cultivators of the soil, but by industrious artisans, doing the work which that scientific utilization of water power provided for them. It was only people at a distance who concerned themselves with the sentimental question as to what would become of the beautiful falls He did not himself utter the aspiration that these falls might go on forever in all their beauty. When the time came for every drop of water that now fell over the falls to be used for the benefit of mankind, no man who thought of the good of the people would regret that the power in the waterfalls was developed for the general good.

These views do not command the cordial support of the British press, as is shown by the following comment of the London Electrician, which is fairly representative of public opinion on this subject:

"It seems to us that these remarks of the venerated leader of the electrical profession are permeated by

that spirit of subdued fanaticism characteristic of so many engineers. Except that the re-peopling of the Highlands by 'industrious artisans' instead of by 'cultivators of the soil' would lead to larger engineering orders, we do not see how the algebraic sum of human happiness would be increased. And as for the water of the Falls of Foyers be used for 'the benefit of mankind' and 'the general good,' we would only remark that we had no idea that the shareholders, employes and customers of the British Aluminum company were so numerous. There is also, it would seem, an underlying assumption that a worker in metals is a better man than a tiller of the soil, and that benefit connotes only material, pecuniary gain; otherwise there could be no possible cause for enthusiasm in the substitution of manufacturers for farmers at the expense, or largely at the expense, of some of the most health-giving scenery in the United Kingdom. Of course the day may come when, by reason of the exhaustion of the world's coal supplies, every available fall of water and every available windy hill-top will be eagerly sought after for 'the benefit of mankind,' aye and for its very existence. Until that day of doom arrives engineers would do well, from the point of view of mere policy, to assume a virtue even if they have it not, and show some outward respect for the tender susceptibilities of the sentimentalists who prefer a

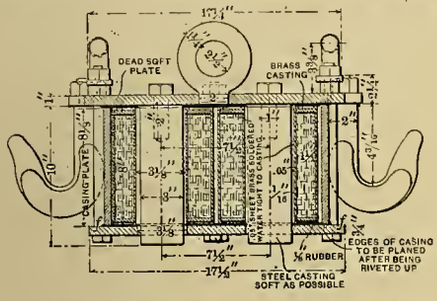


FIG. 3. LIFTING MAGNETS IN A PLATE MILL.—SECTION OF DOUBLE-POLE MAGNET.

high waterfall to a long pipe line and the perfume of the pine to the smell of sulphuretted hydrogen."

Lifting Magnets in a Plate Mill.

Many attempts have been made to make the attractive power of the electro-magnet a factor in the practical work of factory and workshop, but seldom on a larger scale than in the plate mill of the Illinois Steel company, as shown in the photographic reproduction of the interior herewith given (Fig. 1).

The Wellman magnets are installed, and the Iron Age gives these details: The magnets first designed were of the double-pole type, as shown in Figs. 2 and 3, and were put in use at the Otis Works in 1889. This first magnet was designed for loading four by four inch billets from a pile in the stock-yard onto cars for shipment, but it was found upon putting this magnet into use that it was not practical, on account of the billets being so thoroughly entangled in the pile. The magnets were then attached to a crane in the plate mill and used for handling plates, and have been used since then in several large concerns with very satisfactory results.

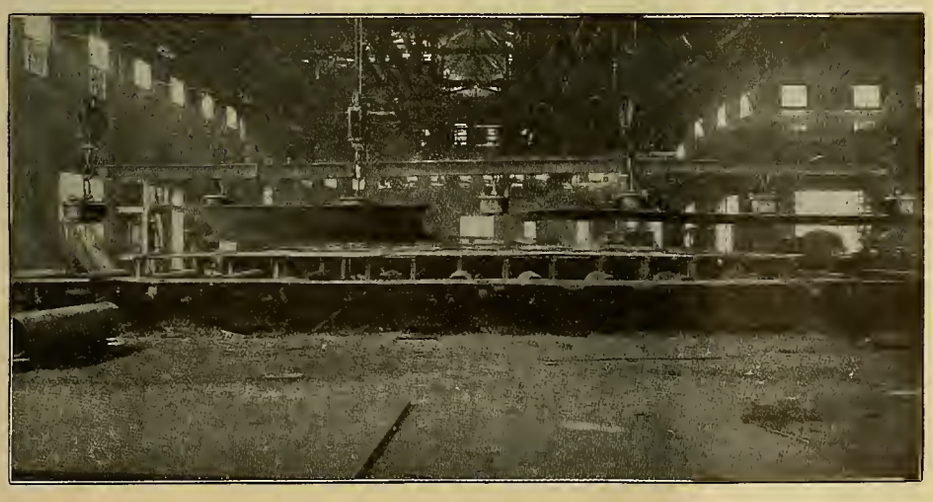


FIG 1. LIFTING MAGNETS IN A PLATE MILL.

Magnets for this work in connection with an electric traveling crane are specially well adapted for handling plates, as the connections to the magnet are placed on the bridge of the crane in the same manner as the connections for the operating motors, and after the magnet is placed on the plates to be lifted the electric connection is made by means of an ordinary switch placed in a convenient position in the operator's cage. The magnets are so designed that they are practically water-proof, and can be used for handling plates and other material out of doors. The double-pole magnets in use by the Illinois Steel company can handle with safety five tons, and only take about four amperes, with a 240 volt current.

Considerable difficulty was experienced on first starting the magnet in picking up single plates from a pile, as the magnetism was carried through several plates. The operator, however, in a very short time became expert in operating the switch. After the magnet has been lowered onto a pile of plates and several plates have been taken up together, the operator simply pulls the switch out, thereby breaking the current for an instant. By this operation one or two plates can be dropped off at each breaking of the current, enough residual magnetism remaining in the plates next to the magnet to hold them until the current is again switched on. This operation is continued until only one plate remains

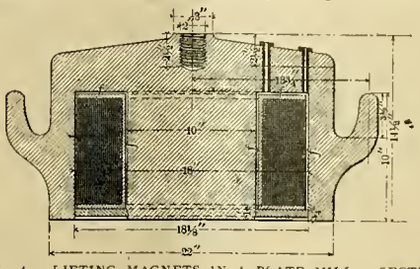


FIG. 4. LIFTING MAGNETS IN A PLATE MILL.—SECTION OF SINGLE-POLE MAGNET.

attached. The concentric pole magnet (Fig. 4) was specially designed for handling hot plates and ingots, and there has been no difficulty in handling a 6,000 or 8,000 pound ingot at a low red heat.

The effective use of electric magnets in this manner has been limited. But where the iron or steel to be handled in such shape that it is possible to get a good contact, there is no doubt that it is the most economical and rapid method of handling. A great many concerns have been afraid to put magnets into use on account of the apparent danger of dropping the material and thus endangering the men who may be at work. In years of experience the company supplying the magnets does not know of a single case where anyone has been injured by the material dropping, and it firmly believes that it is the safest way possible to handle certain classes of iron and steel product. The magnets are so designed that it is impossible for the men that are placing them to receive a shock.

Electrical Vehicles.

There seems to be a considerable interest in electrically propelled vehicles at the present time. In Chicago, for instance, the American Electric Vehicle company is turning out rather a gorgeous lot of delivery wagons for Charles A. Stevens & Brothers, the silk merchants. The first installment of two wagons have been on the streets for a week, and they have not only performed the work for which they were intended, but they have likewise proved an excellent advertisement. Four more wagons, similar in every respect to those now in use, are nearing completion, and they will be pressed into service as soon as they are ready.

Two light vehicles and a couple of rigs known as runabouts are now being gotten ready under special orders for prominent Chicagoans.

Advices from London indicate that the electric cabs that were introduced a few days ago on the streets of London are in great demand. Only two of them are plying for hire, the others having been privately engaged for 25 shillings a day. The company owning the vehicles says that it could let hundreds of them if it possessed them. They resemble coupes, and the accumulators consist of 40 cells, capable of propelling them over 50 miles at a cost of 50 cents. The rear wheels do the driving and the front wheels the steering. They have heavy rubber tires, have upholstered spring cushions, are lighted by electricity, are speedy and almost noiseless. They appear to be giving satisfaction. The machines seem under perfect control and thread their way wonderfully through the traffic. The tariff is the same as that of the cabs.

"Electric Sleighs" on the Yukon.

The Chicago Record correspondent at Seattle, Wash., announces that "winter travel to Dawson City will be one of the features of this year's great Klondike rush if Chicago business and railroad men succeed in a novel transportation scheme. They propose an 'electric sleigh' service from the headwaters of the Yukon River and the lakes to Dawson City in sleighs capable of traveling 60 miles an hour on a smooth surface." The letter says that the sleighs will be furnished with upholstered berths, heated and lighted by electricity and "operated by a motor." The source of power and method of application are not disclosed, nor are the details of construction explained, but the story is a good one and is as likely to contain as much truth as most of the yarns that come from that wonderland.

Telegraphers' Troubles in England.

Fines have been imposed upon the leaders of the Telegraphers' association in England because of their action in inciting the clerks to insubordination, and this has naturally increased the tension between the men and the government. It is pretty generally conceded that the telegraphers overreached themselves. They bluffed the postmaster-general successfully into reconsidering their case, and ought to have abandoned the game, which could have yielded no more points for them. But when the government reconsideration was discovered to have been merely a subterfuge to carry matters over until the prorogation of Parliament the telegraphers got angry and

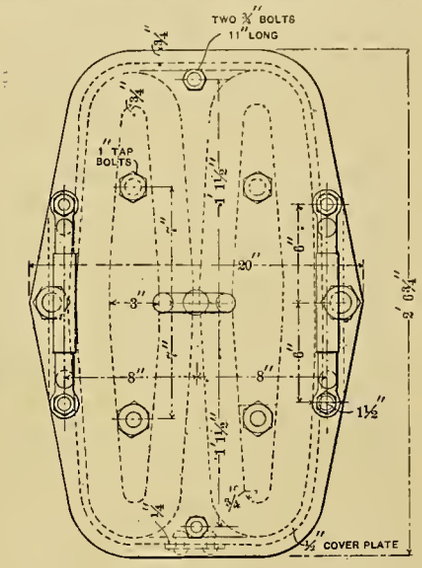


FIG. 2. LIFTING MAGNETS IN A PLATE MILL.—PLAN OF DOUBLE POLE MAGNET.

resorted to the old methods. Then the Duke of Norfolk showed his teeth, and immediately the would-be mutineers fled in wild dismay. The government has won and the telegraphers know it. In the course of the struggle which has been going on virtually since last May the telegraphers have learned that there are a good many outsiders who can manipulate Wheatstones and Morse sounders. The discovery was an unpleasant one to the men, and they will now proceed to bring these outsiders into the union fold, so that there may be no outsiders when the next struggle comes.

Fifty-year Franchise Wanted.

Residents of Austin and Oak Park, two of Chicago's most populous suburbs, have long desired a five-cent transportation rate to the heart of the city. Originally the Cicero board made an agreement with the Lake Street Elevated Railroad company to the effect that this single fare should be granted in exchange for certain right-of-way which the corporation sought from the town authorities. When the "L" company passed into the control of Mr. Yerkes this contract was cancelled, and Mr. Yerkes forfeited a $25,000 bond executed by the former owners of the "L" company in guaranteeing their contract. Mr. Yerkes, however, has made a proposition to replace the $25,000 bond by a new bond for $100,000 guaranteeing that the Lake Street "L" will be extended to Austin avenue within 18 months and a five-cent fare to the city granted, provided the franchises held by his corporation in the town of Cicero are extended from 20 to 50 years.

Discussing the development of the steam turbine, a recent writer states that within the last five years direct-coupled turbine dynamos of 500 to 700 electrical horse power, both condensing and non-condensing, have been constructed and put to work, and at the present time about 30,000 horse power of these motors are at work in England.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

HIGH WATER MARK

CIRCULATION, 20,000.

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With the Niagara Falls convention number of the Western Electrician, dated June 12, 1897, this journal made a new record for itself both in circulation and advertising. Of this 100-page number 20,000 copies[1] were printed and circulated and the amount of full paid advertising matter carried was 8,643 square inches.

Beginning with the convention number of March 3, 1894, the record shows constant gains each year until in the present case the number of square inches of full paid advertising matter is more than double that of the 1894 number. The figures showing this unprecedented gain are given in the accompanying table:

Issue	Number of Advertising Pages.	Whole Number of Pages.	Square Inches of Paid Advertising Matter.
March 3, 1894	40	56	4,145
February 23, 1895	52	68	5,593
May 9, 1896	72	88	7,576
June 12, 1897	80	100	8,643

This constantly increasing patronage speaks eloquently of the influence and merit of this journal and of the confidence and respect which it commands throughout the country. It is pleasing recognition of the efforts that have been made in the interest of the entire fraternity.

George B. Pennock of battery fame is entitled to rank as prince of promoters. He has hypnotized the Sun's office cat and exploited his "wonderful" inventions through that journal. If you see it in the Sun, you can't tell.

Years ago the thief who was daunted only by a hot stove was regarded with amazement by those who recognized daring wherever displayed, but his adventures pale into insignificance when compared to the light-fingered gentry of the present year of grace, who have distinguished themselves by stealing a quantity of wire from a central station company of New York, carrying current at remarkably high voltage. Evidently there are experienced linemen in New York out of employment.

Street railway men of Cincinnati are bestirring themselves to secure the convention of the American Street Railway association for their city in 1898. Formal invitation will be extended the organization when it meets at Niagara Falls in October, and the advantages of Cincinnati as a convention city will be duly impressed upon all in attendance at that meeting. The fact that there is already provided a splendid convention hall at Cincinnati, in connection with which there is an enormous power building for exhibition purposes, should have considerable influence in determining the choice of the organization. There is also assurance that the delegates and visitors will be well cared for, as the local companies and the merchants of the city are anxious to have the meeting held in Cincinnati and will see to it that every comfort and convenience is furnished.

Encouraging reports of the commercial situation are received from all parts of the country, indicating marked improvement in all lines of trade. The commercial agencies' reports are the most encouraging that have yet been offered. Bradstreet's, for instance, says: "No such volume of business, largely in anticipation of requirements, has been reported since 1892," and Dun's says: "Not for several years have the telegraphic reports from various cities in all parts of the country been as encouraging or shown as uniform improvement as this week. The markets are called crazy by some, but fairly represent the people, whose confidence in the future is strong and increasing. Nothing appears to check it." There were 221 business failures reported throughout the United States last week, as against 264 a year ago. The third week in August has been a trying period of late years, and in 1893 there were 456 failures reported throughout the country.

Some interesting statistics showing the progress that is being made in electric lighting in Germany have just been gathered for publication. On March 1st, it is reported, there were 265 central stations in operation, and 82 in course of construction or definitely projected. This is a notable advancement, as in 1894 there were only 148 central stations in operation in Germany and at the time of publication of the last reports, October 1, 1895, this number had increased to 173. Of those in operation at the present time 204 employ continuous current only, and 26 alternating current. The capacity of the former has increased 54 per cent. since 1895 and the latter more than 150. The use of three-phase current also shows a decided increase. On examination it appears that while only 57 per cent. of the stations depend entirely on steam power, the steam plants represent 84 per cent. of the plant capacity of all the stations. The 17 per cent. of the stations driven by water power alone are generally the smaller ones with less than 100 kilowatts output, there being only 10 of over 100 kilowatts capacity, although this includes one item of 1,360 kilowatts. Six plants, aggregating 460 kilowatts, are driven entirely by gas engines, and in other cases gas engines are used as reserve. It is found that 133 out of the 265 have less plant capacity than 100 kilowatts, and there are 21 of over 1,000 kilowatts, including nine over 2,000 kilowatts. The largest plant is the Manerstrasse station in Berlin with 5,486 kilowatts capacity. The total plant capacity of the five Berlin stations is 10,968 kilowatts. Another interesting point developed is that the motor connections correspond to 23.5 per cent. of the entire load of the German stations. In 1897 there were 1,025,785 "incandescent lamp connections in terms of 50 watt lamps," as against 622,986 in 1895 and 493,081 in 1894. The number of 10 ampere arc lamps in operation at the time these returns were made is reported as 25,024, while in 1895 there were 15,396 and 12,357 in 1894. The motor load in horse power is given as follows: 1897, 21,809; 1895, 15,396; 1894, 5,635. As a matter of fact, the motor load has increased out of all proportion to the lighting load.

The address delivered by Lord Kelvin last week before the British Association at Toronto on the "Fuel Supply and Air Supply of the World" was the feature of the meeting, and it was worthy of all the consideration which it received. It was really a strong plea for the cultivation and preservation of forests as the only safe and practical means of prolonging the supply of the earth's oxygen so as to enable man to make use of the enormous stores of fuel deposits which otherwise would be useless. The speaker first determined the limit of the total amount of the fuel supply of the world, that which is relied upon for the future needs of life and civilization. The supply, he said, was limited in amount by the total quantity of oxygen available to consume it. He had calculated that there was 510,000,000 million tons of oxygen, which would burn 340,000,000 million tons of fuel obtainable from the existing coal measures, the oil-bearing strata, the forests and some minor sources, the latter including the vegetable mold which will contribute to the vegetation of the future. It is obvious, however, that far less than the amount named can be used by man, as long before all of it was consumed the human race would cease to be able to breathe, and therefore could not live. Moreover, the estimated supply provided 200,000 tons of fuel only for each person alive to-day, and therefore left but a limited span for life on the earth. The hope of futurity rests in vegetation, which indefinitely prolongs the process of consuming the earth's oxygen, and makes it possible to use the enormous stores of fuel deposits which exist on the earth. Lord Kelvin did not believe that much relief could be expected from the utilization of natural water powers. The total energy now being developed at Niagara he rated as less than that of four ocean liners, and if all the water in the falls could be made to turn wheels the result would be less than 100 of the great transatlantic ships. Taking all of the waterfalls of the world into account, the speaker declared they made but an insignificant showing in the task of furnishing power for the world.

Another feature of the address was the plea for the universal adoption of the metric system of weights and measures. The speaker expressed the hope that soon the Canadians and the British colonists, Great Britain and Ireland would shake off the bondage of the old and complicated system of acres. "Perhaps the Dominion will precede England in that respect," he concluded, "and make all government contracts and reports in the French metrical system, and I believe in a very few years it will be universally and cheerfully adopted." This suggestion was not received with universal approval, however.

1. State of Illinois, County of Cook—ss:
Frank Foster Kenworthy being duly sworn deposes and says that he is a resident of the city of Chicago, in the county of Cook and state of Illinois, and that he is the superintendent of the binding department of the Electrician Publishing company, the publishers of the Western Electrician; that he was present at and superintended the binding of No. 24 of Vol. 20 of the Western Electrician, issued on June 12, 1897, and that there were sent out by actual count 20,000 complete copies of said Western Electrician of the volume and number above specified.
And further this affiant sayeth not.
FRANK FOSTER KENWORTHY.
Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

Constant Potential Arc.[1]

By O. M. Rau and F. A. Vaughn.

The incandescent arc light, or the arc light in multiple on constant-potential circuits, is very little applied by the smaller plants, and, in view of the present development of this branch of the lighting art, there seem to be no good reasons for this inaction.

Let us apply the incandescent arc to the problem, not that its extensive use is to be advocated here, but simply to keep your customer on your service. Although you may, perhaps, make no appreciable profit from the contract, you will have gained the advantage of having kept your competitor from advertising his light and will have increased the efficiency of your station, if understood, to say nothing of keeping in use meters, wires, cut-outs, etc., which would otherwise be scrap or dead stock. Light equivalent to 40 16 candle power lamps can be obtained from two 450 watt arc lights of the open or enclosed type fed from the same service as the incandescent light. The distribution of light may not be as effective as from the incandescent lamp, although with the enclosed arc very good diffusion and quality is obtained, but the general effect will be very pleasing and no doubt satisfactory.

With this method of lighting the customer's bill will be about one-half of that of Welsbach lamps, and nine times out of ten this proposition will keep the customer on your mains, particularly in small towns, which are to be especially considered in this paper, where perhaps an arc light is a novelty and a good "ad." for the merchant.

Not only is this proposition available as noted, but may be used to obtain new business where every other method has failed, and it is especially recommended where the generating plant is operated under three-quarter load, as it will then increase the efficiency of the plant and the net profit on the present load, leaving out the consideration of a margin from new business.

The first question arising from this proposition is, Who shall pay for the lamps? This causes no serious difficulty with the Welsbach man; he simply proves this to be a first investment which will be paid for in a few months by the reduced bills. But the electric light solicitor has the same advantage, which should be supplemented by the additional inducement that a remittance of the cost of lamps, less 10 per cent., be allowed if the lamp is returned in good condition. This will obviate the necessity of any increased investment in apparatus being incurred by the electric light company when new customers are connected to its mains, and will give the customer some security on his investment. In large stations where a variable demand for lamps of this class prevails they are invariably the property of the company, except when other than plain lamps are desired. Ornamental lamps should in all cases belong to the customer.

The question of carbons and trimming should be entirely in charge of the station and the expense borne by it. This expense, especially with a 100 hour lamp, is very small and would not perceptibly increase the cost per watt-hour, and the trimming can readily be taken care of in connection with the street-lighting system or by one of the assistants in the station, causing no extra expense.

From these remarks it will be seen that, while arc lighting from incandescent circuits may not be as desirable as incandescent lighting, it is the only method which our central stations can adopt to successfully meet competition from other artificial methods of illumination.

In connection with this subject it was thought that it might be of interest to note a few advantages and disadvantages possessed by the several types of incandescent arc light system, and to take a cursory glance at the state of development reached.

A few points in favor of incandescent arcs as a class over series arcs may be cited: Independence of light units and flexibility of the system; less liability to burn-outs and other advantages possessed by low-potential generators; low voltage and consequent safety to human life; easy maintenance of insulation of lines and dynamos; ease of installation together with incandescent lamps (two sets of mains being no longer necessary); facility of metering current supply; relative safety of low-potential dynamos from lightning; feasibility of operating lamps of various candle power from the same dynamo; greater efficiency in production of current, equal to 25 per cent. or more, due to feasibility of using large generating units at a lower potential, and more efficiently designed generator and engine units. A 50 kilowatt constant-potential incandescent dynamo can be guaranteed a commercial efficiency due to direct connection and slow speed; while an arc light dynamo with an efficiency of 80 per cent. when new may depreciate to 70 per cent. and often to 55 and 50 per cent., although modern arc light dynamos of 100 lights capacity may have a commercial efficiency of 86 per cent. when new, or 82 to 83 per cent. for a 60 lighter.

The greatest disadvantage is that a dead resistance must necessarily be included in the lamp branch of the circuit, which entails considerable loss of power. Regarding this use of resistance, Prof. Elihu Thomson stated some time ago that a great deal of useless experimenting had been and probably is yet carried on in the vain endeavor of getting rid of the existence or choking coil in this case, but the difficulty is inherent in the nature of the arc; the relations of R to C giving rise to instability of current in the arc; and in his recent paper before the National Electric Light association he shows that a certain line voltage as a minimum is absolutely necessary in working satisfactorily arc lamps on constant potential lines, whether they be open or enclosed arcs; thus two 45 volt open arcs in series require at least 110 volts on the line with a resistance in series with the lamp. This entails a drop of 20 volts in the resistance, with consequent loss. If one similar arc be used, this drop is increased to 65 volts. If one 80 volt arc be used it will require at least 100 volts, so that with either open or enclosed arcs at ordinary current strengths of from five to 10 amperes the steadying resistance in the lamp branch is required to cause a drop of about 15 to 20 volts. The loss due to this dead resistance, added to the loss in line and feeders may overcome the 25 per cent. or more increased efficiency previously noted as an advantage. Also a more expensive carbon of better quality is required for constant potential use. Both of these disadvantages assume importance if a plant were to be operated exclusively with this style of lamp, but from the point of view taken in this paper they are of minor consequence. The loss due to external resistance can be cut in on either side of the meter. When the consumer pays for this the relative saving on his bill is affected, but this is not to be recommended.

To meet the various conditions arising in practice, numerous constant-potential arc lights have been designed, viz.: the direct current constant-potential open arc, where the carbon points are subjected to unlimited air supply; alternating current constant potential open arc similar to the above, but adapted to alternating currents; direct current constant-potential enclosed arc, where the carbon points are surrounded by a glass envelope or small globe, whereby the ingress of air to the arc is prohibited by a valve, and egress of CO and CO_2, formed by combustion is regulated, and the alternating current constant-potential enclosed arc of a similar nature to the last mentioned.

Open arcs, burning singly, on 110 volt circuits, while possessing the advantages of flexibility and independence, are very wasteful and should never be resorted to, the cases where only one lamp is required being seldom met.

Any arrangements of the lamps in series, as for instance, two in series across 110 volt mains, four in series across 220 volt mains, five or more in series across railway circuits, are considerably less wasteful, but they have not the advantage of flexibility and independence.

It is to be regretted that no alternating current constant-potential arc light can ever be as efficient as the direct current arc. This is owing to the cooling effects of the zero points in the alternate current wave, and consequent lowering of the temperature of the arc, and owing to the fact that the reversals of the alternating current form craters on both upper and lower carbons, each of which is relatively small, and the light from the lower carbon can be utilized only by reflection with consequent losses. The total mean spherical candle power of an alternating arc is therefore less than that of a unidirectional arc for the same expenditure of energy. Lowering the frequency of the alternating current decreases the efficiency, as might be anticipated, because of the greater cooling effect of the zero or dead points in the current wave, with the lower frequencies and resulting longer time required to pass from positive maximum to negative maximum. Seven thousand two hundred or 16,000 alternations per minute are very well adapted to running alternating current arcs, although lower frequency than the former would approach the limit of good practice. Nevertheless, the alternating arc light system possesses all the advantages belonging to alternating current distribution systems, as well as extreme flexibility and absolute independence.

The alternating current constant-potential open arc may, of course, be used singly, or in series of two or more, across 110 volt mains, considerably more efficiently than the corresponding direct current lamps, as a well designed reactive coil may be used as a substitute for dead resistance with but very small loss.

The most desirable method of utilizing the alternating current constant-potential arc is by transformation of the current from the high-potential mains and applying it directly to each individual lamp. The transformers or economy coils used for this purpose have very high efficiencies.

The alternating current open arc light will require 32 volts across the arc, but the transformer must have a secondary voltage of about five volts greater than this, which extra voltage should be taken up by the steadying or choking coil. An economy coil with the secondary voltage of 37 or 38 volts will operate one 2,000 candle power alternating current open arc very efficiently. This will require 12 or 13 amperes, with a resulting life with cored carbons (which are essential) 9½ inches by 7-16 or ½ inch, of from 10 to 12 hours. The line losses will be small, as only about one-half ampere in the 1,000 volt mains will be required for each lamp. Economy coils of 50 volts or 110 volts, secondary voltage, may of course be used by a suitable arrangement of the lamps in series and the reacting or choking coils.

A very desirable plan is to supply the alternating arcs from the otherwise useless old 50 volt transformers, which most of us undoubtedly have stored away with other abandoned apparatus.

It must not be forgotten, however, that short-circuiting of any of the above constant-potential transformers is not only undesirable but detrimental to the apparatus, and therefore to avoid excessive currents, should the carbon points come together or fail to strike an arc, the lamp mechanism must be designed to throw in a resistance or reactance equivalent to the arc in such emergencies. The latter difficulty can be overcome and the reactance substitute avoided by the use of a transformer which, if designed with considerable magnetic leakage between primary and secondary coils, will give an approximately constant current. This means that if a transformer be designed for 9.6 amperes in the secondary, at a pressure of 48 to 50 volts, and the resistance of the secondary circuit is decreased, by shunting the lamp or otherwise, the secondary voltage rapidly falls, reaching zero when the terminals are short-circuited, the current varying only a few per cent. from light to full load. It will give an efficiency of over 87 per cent. at the lamp, and allows of the use of ordinary arc light carbons for this work instead of expensive cored carbons. A 2,000 candle power alternating current open arc burning on the secondary of this transformer obviates the necessity of inserting any resistance or reactive substitute when one or more of the lamps in the series is extinguished. The current remains practically constant, though only one, or even none, of the lamps be burning. While the regulation of any of the constant potental arcs, burning singly, may be accomplished by a series coil only, depending simply upon the current flowing in the branch, the regulation of an arc burned on a constant-current transformer must be accomplished in a manner similar to that used in any constant-current lamp mechanism having a shunt coil across the arc.

The enclosed arc light is a comparatively recent development brought out to obviate some of the difficulties inherent in previous arc lamps for constant potential circuits.

It was found that by enclosing the arc in a small glass chamber, sufficiently thin to withstand heat and sudden changes in temperature, and covered with an opalescent coating to efficiently diffuse the light, that the life of the carbons was enormously increased, that the voltage across the arc could be nearly doubled, and that the quality of the light was very pleasing and well diffused.

In the course of experimentation, there developed the necessity of supplying some means of egress for the gases CO and CO_2, formed by the combustion of the carbons, in order to prevent too frequent bursting of the enclosing globe. A check valve is therefore used, which will allow the gases to escape should the internal pressure increase dangerously, but will prevent any abundant supply of oxygen from entering the chamber and coming in contact with the incandescent carbon points. Owing to the exclusion of a sufficient amount of oxygen to support combustion in any great degree, the life of 12 inches of one-half inch carbon is increased to from 100 to 150 hours, with consequent lengthening of time between trims. The saving in cost of carbons and trimming is evidently considerable, and this allows of the use of the more expensive grades of carbon so necessary to the satisfactory working of constant potential arcs. It has been stated that the cost of carbons would equal only about one-twentieth that of the open arc, while the cost of attendance will be but one-tenth as great.

The annoyance of trimming, so strenuously objected to by some customers, can no longer be considered a serious objection with this style of lamp, and the still more pressing objection raised by merchants and dealers in perishable and inflammatory goods, and sustained by fire insurance companies, on account of the sparks and carbon dust thrown down from an open arc, is met by the enclosing globe, forming a perfect spark arrester, and by the entire consumption of the carbon dust by the arc, with no blacking effect on the globes, making a very cleanly and safe light for interior use. It is also a fact that the efficient diffusive effect, uniformity and good quality of the light and absence of shadows are wonderfully marked.

The high voltage at which the arc may be maintained admits of one lamp being used with good efficiency across 110 volt circuits, thus obtaining the advantage of absolute independence.

Nearly double the usual voltage (about 80 volts) being required across the arc, correspondingly small currents will produce steady arc lights of standard candle power, free from noise or chattering.

The regulation of the arc in this case will be accomplished by a series solenoid or magnet, responding to variations in the current passing through the arc, which makes an extremely simple mechanism and one easily kept in repair.

The simplicity of lamp mechanism is taken advantage of and a lamp constructed which is extremely short, ornamental and well proportioned, possessing none of the lean, attenuated qualities of the familiar type of open arcs. These lamps are made as short as 24 and even 16 inches, making a lamp scarcely larger than an incandescent 16 candle power lamp with globe attached.

Owing to the very slow consumption of the carbons, and small variation in the length of the arc, this lamp feeds only once in a relatively great length of time. This quality adds considerably to the steadi-

1. Read before the Northwestern Electrical association at La Crosse, Wis., June 22, 1897.

ness of the light, as the flickering and fluctuations of the light, caused when a lamp feeds, occur only every three or four hours instead of every five or 10 minutes as in open arcs, and the advantage of a "sneak feed" is obtained.

Any automatic cut-out, other than a fuse in the lamp branch, is unnecessary when one enclosed arc is burning on 110 volts, but carbons are obtainable which have imbedded in them at a proper distance from the end a piece of refractory and insulating material, which assures the arrest of the arc when the carbons have burned to the proper length, and obviates the blowing of the fuse from the carbons burning too short.

The use of the diffusive coating on the enclosing globe, although it possesses small absorptive power, affects the efficiency of the light to some extent, and the mean spherical candle power of an enclosed arc is slightly less than an open arc for the same energy, but the quality and other properties possessed by the light make it very satisfactory. The objectionable violet hue may be varied by proper coloring of the globe. The ordinary opalescent outer globes of undue thickness and absorptive power are unnecessary.

The arc rotates or migrates from one side to the other of a blunt-ended carbon of the usual type, but the diffusive power of the inner enclosing globe does away with this entirely, especially when cored or slit carbons are employed to confine the motion of the arc within small limits.

The enclosed type of arc lamp has been adapted to alternating currents quite successfully of late, and it would seem to have quite a brilliant future before it. This type can be used on alternating mains of from 100 to 120 volts, and possesses the same advantages over the direct-current enclosed arc which the open arc of the former class has over the direct open arc, the principal one being the small loss due to the use of a reactive coil instead of dead resistance.

The greatest economy to be obtained by any of these methods would be by installing the enclosed alternating arc light with suitable transformers, thus obviating the use of wasteful resistance or reactance, and retaining all the advantages possessed by independent light units on flexible systems, as well as those of the long-burning arc. The alternating closed arc lamps are made to burn on frequencies of either 7,200 or 16,000 alternations per minute.

Aside from the considerations, pro and con, from a scientific standpoint, it is confidently believed that the constant-potential arc in almost any of its forms will meet all requirements of a successful rival to the numerous other artificial lights, and the use of this method would certainly be a more legitimate way of suppressing "the enemy" than that followed in the past.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the Western Electrician.]

Geo. R. Thompson has been granted a franchise at Chatfield, Minn., which allows him to put in a telephone exchange.

The Forman Telephone company will extend its long-distance line at once from Forman, Lidgerwood, Great Bend and Hankinson to Wahpeton and Milnor, N. D. The line is to extend to Sheldon and Lisbon and possibly other places.

The People's Telephone company has been incorporated at Mt. Hope, Wis., with $1,072 capital stock. Andrew Cairns is interested.

The Sibley County Telephone company has been granted a franchise at Gibbon, Minn.

The Western Minnesota Telephone company of Glencoe, Minn., will probably put a long-distance line between Redwood Falls and towns of that county.

The Mutual Telephone company of Des Moines, Ia., has connected with 200 of its subscribers and expects to have the remaining 675 connected by September 1st. The Iowa Telephone company will cut rates at Des Moines after September 1st.

The Northwestern Telephone company has been granted a franchise in Centerville, S. D. It is said that the Northwestern Railroad company owns this system.

The council of Chippewa Falls Wis., granted a telephone franchise to J. E. Keelyn of Chicago. The mayor vetoed the franchise and the veto was sustained, those in favor of the franchise lacking one vote of the necessary two-thirds to carry it over the veto. An attempt will be made to formulate a franchise evading the objections of the mayor.

The Cedar Valley Telephone company reports an increase of 20 per cent. in its business for six months at Waterloo, Ia.

Telephone service at Burlington, Ia., is very cheap, owing to the rate-cutting started by the Iowa Telephone company when the Mississippi Valley company's exchange was completed. Residence phones are $15 a year and party lines are $8.

A telephone line is being constructed between Sigourney and Lancaster, Ia.

Chas. M. Waterbury, general manager of the Phœnix Telephone and Construction company of Indianapolis, died at Lake Minnetonka this week, aged 32 years.

The Stanton Telephone company expects to have its exchange in Great Falls, Mont., completed and operating by October 1st.

The Wapsie Valley Telephone company has been formed at Troy Mills, Ia., to build to Arlington, Ia., and intervening points.

Outing of Electrical Men at Sandy Hook.

A jolly party of electrical men responded to the invitation of President Benjamin M. Whitlock and General Manager Leonard F. Requa of the Safety Insulated Wire and Cable company of New York, meeting at the Bay Ridge boat landing in New York on August 18th to participate in a day's outing. Among those present were the following-named gentlemen: Charles Blizard, A. L. Salt, E. F. Peck, Nelson W. Perry, J. N. Lavens, Chas. J. Klein, W. F. Wells, J. C. Hatzel, J. B. Falkner, Jr., J. F. Outwater, Chas. A. Edwards, J. Elliot Smith, Sol. Davis, Edgar L. Morley, W. F. Hunt, James Jones, Jr., James Ferguson, W. J. Johnston, W. H. Tapley, W. Alexander Henderson, Stephen L. Coles, F. S. Blackall, W. F. Osborne, H. F. Stevens, H. S. Anderson, Burton G. Loomis, James Leitch, James Kite, John E. Gordon, M. R. Brennan, J. K. Dexter, Harold P. Brown, C. A. McGrew, Wm. H. Foley, G. C. Allen, M. Carrichoff.

The guests were met by H. T. Richards, I. W. Henry, A. P. Eckert and J. B. Parsons, representatives of the company, and were conducted to the Atlantic Yacht Club float at Bay Ridge, and then taken in naphtha launches on board the beautiful steam yacht Hildegarde, where a welcome was extended the party by President Whitlock and General Manager Requa. In a few moments straw hats were exchanged for yachting caps, and the Hildegarde headed for the fishing grounds off Sandy Hook. During the trip down the bay, amusement was furnished the guests by the Neapolitan Quartette in native costume and Cooper and Miller. L. G. Day sang a number of songs of his own composition, and related stories to the great delight of those present. Lunch was served en route. About noon the expedition arrived at the fishing grounds. Previous to embarking in naphtha launches to board the eight fishing sloops which awaited the party, fisherman's overalls were supplied to all those who cared to indulge in the sport. Amusements were arranged for those who remained on board the yacht. Chumming for bluefish off Sandy Hook is not always attended with success, but there was a splendid catch on this occasion in all of the sloops, in spite of a severe squall which raised a heavy sea. The collection was varied: bluefish, shovel-nosed sharks, dogfish, skates, sea robins and sea possums were all proudly held up by the enthusiastic fishermen to admiring friends on their return at five o'clock.

The yacht Hildegarde, which is the property of President Whitlock, is one of the noted boats in New York harbor. Its dimensions are 120 feet in length and 20 feet beam. It was originally owned by the Prince of Wales, and has made several trips around the world. It is fitted with a complete electrical outfit, one feature being a reproduction in incandescent lights of the private flag of President Whitlock, who holds the rank of rear commodore in the Atlantic Yacht Club.

OUTING OF ELECTRICAL MEN AT SANDY HOOK —YACHT HILDEGARDE.

The following resolutions, signed by the entire party, were presented to President Whitlock and General Manager Requa: "Off Sandy Hook, August 18, 1897. We, the assembled guests of the Safety Insulated Wire and Cable company, in the fullness of our hearts and bodies, cannot refrain from giving expression to our feelings of gratitude as follows, to wit: Our thanks are due, and are hereby heartily tendered to President Benjamin M. Whitlock, rear commodore of the Atlantic Yacht Club, for his hospitality in placing at our disposal his auxiliary steam yacht, the Hildegarde, and an equal number of thanks we hereby tender to General Manager Leonard F. Requa of the Safety Insulated Wire and Cable company for the entertainment (physical, mental and musical) which we have this day enjoyed aboard the Hildegarde. Safety forever!" Three cheers were heartily given for President Whitlock and General Manager Requa. President Whitlock responded by a salute from the yacht whistle, and invited the party to join him at dinner at the Atlantic Yacht Club, where a generous repast was provided.

Expressions of regret were received from Nikola Tesla, Thomas A. Edison, Gen. Thos. T. Eckert, Charles R. Huntley, U. N. Bethell, A. B. Chandler, George W. Ward, Samuel Insull and many others, who were unavoidably detained.

Scrubbing by Electricity.

A Cleveland janitor, H. F. Ackerman, has invented an electrical scrubbing machine. Rapidly revolving brushes are driven by a motor at the rate of 400 revolutions a minute, and the operator simply pushes the machine over the floor. The brushes cover a space 24 inches wide and the motor is of one-half horse power. The inventor says that he can scrub 15,000 square feet in three hours, less than one-third the time formerly required when it was all done by hand, and besides this reduction in time there is also a great reduction in the amount of help required.

F. C. Manning of Sumter, S. C., says that he is contemplating the erection of a telephone exchange of 100 instruments.

Thunder and Lightning.

All parts of the East were visited by severe storms on Sunday, August 15th, especially New England. At Pine Point, Vt., a heavy storm broke over Lake St. Catherine, its coming being heralded by a report like that of a cannon and a blinding flash of lightning. When the report was heard a ball of fire was seen to descend and strike the peak of the house and three young ladies who were approaching the porch and all the ladies who sat in front of the door were thrown to the ground senseless, stunned by the terrific shock. Nearly all the ladies were scorched or burned about the arms or feet, and one young lady suffered from a stinging burn on her left ear. The floors of the cottage were strewn with splinters of wood from the rafters and door casings, and a looking-glass in the front sleeping room was shattered to fragments. The bolt had struck the front of the peaked roof, followed a row of nails down to and through the floor, and then, following the hinges on the front door underneath, had run part way down to a point where it was diverted by the steel handle of an umbrella standing on the piazza beside the door. The wooden handle of the umbrella was splintered into fragments, and the lightning, running along the steel rod, passed across the piazza and into the ground. Two ladies who sat directly in front of the door were the most severely shocked. The umbrella which diverted the current and gave it an outlet to the piazza and the ground stood directly behind these ladies, and its presence undoubtedly saved their lives. Some strange phenomena accompanied the lightning's visitation. One woman distinctly saw the bolt as it struck under her feet, raising one of them a foot, and passed off the piazza into the earth. A number of celluloid hairpins worn by another woman were scorched to such an extent that they were no longer flexible. One of the victims had been suffering from a slight deafness, but after the shock her hearing became almost normal.

In the Pequot House, New London, Conn., the lightning flashed along the electric wires into the building, and small globes of fire led each other a merry chase over the building and down the wires to the cellar, where they spent themselves in one big flash. At the Heath cottage the family and friends were sitting in one of the rooms when the bolt struck. A rent was torn in the roof, and the electric fluid followed down the chimney, gathering in a bright ball as it emerged from the center of the room and then exploded. Those in the room were scattered in all directions by the shock, and it was some minutes before they recovered. At Councilman A. L. Dean's house on Montauk avenue, the servant girl received quite a severe shock, and the rest of the family had their nerves upset for the rest of the day. The girl, who was in the dining-room at the time, said that three balls of fire came down the chimney and went out of the window.

The house of John Murray of East Hartford, Conn., was struck by lightning, and the occupants had a narrow escape. The bolt penetrated the roof, passed down the chimney, and entered the bedroom occupied by Mr. and Mrs. Murray. The bed in which they were sleeping was struck, the headboard being broken into splinters and the bedpost shattered. The bed dropped to the floor and the couple were badly frightened, but were not injured. The bolt then passed through to the basement and struck a dog, paralyzing it. The walls and roof of the house were badly damaged.

A similar accident was reported from Osborne, Ohio, by the family of C. I. Spencer. Lightning struck the chimney flue and entirely demolished it. Mr. Spencer, his wife and baby were sleeping on a bedstead which was torn almost to pieces and the wire springs were melted in several places. Neither of the occupants of the room was hurt or even shocked. In adjoining rooms were the three daughters, aged 4, 13 and 15 years. The four-year-old child was burned about three inches wide entirely around the body and up the spinal column above the shoulders. The other two girls were

both burned on their bodies and lower limbs and all three suffered severe pain for several hours. The house was badly shattered, most of the plaster falling from the ceiling and walls.

Referring to the frequent instances, during the last year or so, of chemical laboratories being destroyed by lightning, the Springfield Republican notes the singular fact that, while the earlier discoveries in relation to the nature of electrical force found instant practical application in measures designed to safeguard life and property against lightning, the immensely more important discoveries of the present era ignore this phase of the problem altogether, or have little or nothing to offer toward the disarming of the thunderbolt; indeed, the only progress made in this direction has been to prove the worthlessness of the lightning rod—to demonstrate, in a word, the uselessness of the one practical outcome of the earlier discoveries. The lightning specialist connected with the Government Weather Bureau goes so far this year as to maintain not only that rods are of no use, but that most of all the precautions taken by persons to keep out of the path of a possible electrical discharge are useless.

Three trees on New Jersey avenue, Atlantic City, N. J., which have been the home of a large colony of sparrows, were struck by lightning during a heavy thunderstorm on August 13th, and thousands of the birds were killed. The street was covered with the dead sparrows. Lightning also struck a flagstaff on the Daily Union office, shattering the pole and damaging the roof of the building.

A severe thunderstorm occurred at Delhi, N. Y., August 10th, doing considerable damage. A terrific electric storm visited many places in Lewis and Oneida counties at the same time. At Boonville the high-school building was fired by lightning and consideraby burned. A large barn of Ellis Ballou considerably burned. A large barn of Ellis Ballou Charles Cronizer, a cheesemaker, was struck by lightning and killed.

Lightning did considerable damage at the American Brewery, New Orleans, on August 11th. It struck the brickwork of two immense batteries of boilers, by which the machinery of the plant is operated. One of the boilers was undermined and fell with a crash to the ground. The other was not so badly damaged. Two men were injured, one of whom may die.

Lightning struck and killed two horses in a field of Franz Hill, near Trenton, according to the New York Sun. A third horse lying between the other two was uninjured, and was lying quietly between the dead ones the next morning.

At Norwich the members of Charles Champlin's family, on Thames street, were well shaken by a bolt which made a small hole in the ceiling. How the lightning entered or made its exit is a mystery, but it is claimed a year ago it struck in exactly the same place.

Several hotels were struck at Narragansett Pier, R. I., and a barn owned by Edmund Davis of New York was destroyed. The building and contents were valued at $10,000.

Haircut by Lightning.

[From the New York Tribune.]

During the thunderstorm which raged in the eastern part of Dutchess county on Sunday afternoon, August 15th, lightning cut up some curious pranks. Many barns were struck and destroyed by fire. At Millerton, Frank Silvernail's summer resort, the Central House was struck. The lightning went down the chimney into the kitchen, and passed through the dining-room and the billiard-room. In the hotel at the time were the proprietor and several members of the Julian Comedy company. One of the women members was shocked and was unconscious for some time. At Pawling a party of three met with a peculiar experience. Bert Spaulding, his sister Sadie, and a friend were returning from the Quaker Hill camp-meeting, and when the storm overtook them they sought shelter in a barn on William Ludington's place. A heavy bolt of lightning struck in front of the large open door, near which all three were standing. They were knocked down, as was also their horse. For a short time they were unconscious. Upon recovering, Miss Spaulding found that her dress and wraps were badly torn. Mr. Spaulding's gold watch and chain were mutilated, and the hair was singed from one side of his head. The other young man suffered greatly from shock.

Fatal Lightning on His Kite String.

[From the Chicago Record.]

Kansas City, Mo., August 9.—While flying a kite during a heavy electrical storm this afternoon, Walter Vinson, a 12-year old boy, who lived in Chelsea place, Kansas City, Kan., was struck by lightning and instantly killed. The fluid ran down the string, and the lad's hands were burned to a crisp. His body was turned black all over. The body was not found for some time after the storm had passed. The boy was the son of W. H. Vinson, yardmaster at the stockyards.

Lightning Kept the House Vacant.

[From the Lonisville Evening Post.]

Not far from Hodgenville stands an old house which has a wonderful power for the attraction of lightning. It is in an unused field, surrounded by shrubbery and undergrowth. It is only the frame of a once costly dwelling, and has been standing there for 40 years. Strange as it may seem, it has been struck by lightning every time an electric storm has visited that section.

The house was erected by a well-to-do farmer years ago, and was intended for a dwelling for his family, but had to be deserted on account of its habitual subjection to lightning. It has never since been occupied. During a thunderstorm one perpetual flash of lightning plays about the old house. On a dark night, and during a storm, a more beautiful scene could not be found. The whole sky and earth around the old house is brightly illumined by the lightning. The house has been torn away, strip by strip, with each bolt of lightning, until now only a small portion is left standing. So far as is known no fatalities have ever occurred in the house.

Lightning Uncoffins a Victim of Lightning.

[From the Courier-Journal.]

Fort Ogden, Fla., August 4.—Lightning has been very fatal in this section the past month, over eight people having been killed by it. Many strange incidents are related, the most extraordinary being a story from across the Kissimmee river told here today. Henry Myers was killed by lightning there last week while in a field, and buried the next day. The second day a heavy thunderstorm arose. His grave was struck, the lightning tearing open the grave, throwing the coffin out and breaking it open. It was thus found two days afterward by some relatives, and the body reburied. The body was not disfigured by the last electric bolt, but the coffin had been torn to pieces, the body being left on top of the upturned earth, with the splintered coffin fragments around it. This is vouched for by several people from that section.

$200,000 Lightning Flash.

Baltimore, Md., August 15.—During a severe thunderstorm here this afternoon lightning struck the weather vane over the Tunis company's lumber yard at Canton and, descending to the shaving shop, set it on fire. The wind carried the burning fagots, and the immense licorice warehouse owned by the T. S. Young company caught fire and communicated to the McCosker dry dock. Near this were the two-masted schooner Cadet and the old United States revenue cutter Guthrie, which was bought recently from the government and used as a pleasure boat. These, with the licorice warehouse, were destroyed, while only a part of the dry dock was saved. The loss, it is believed, will amount to not less than $200,000.

Struck by Lightning and Burned.

Saratoga, August 13.—During the terrific thunderstorm yesterday afternoon, lightning struck and fired the barn at the country seat of William J. Youmans of New York, editor of the Popular Science Monthly.

Stock Blinded by Lightning.

[From the Indianapolis Sentinel.]

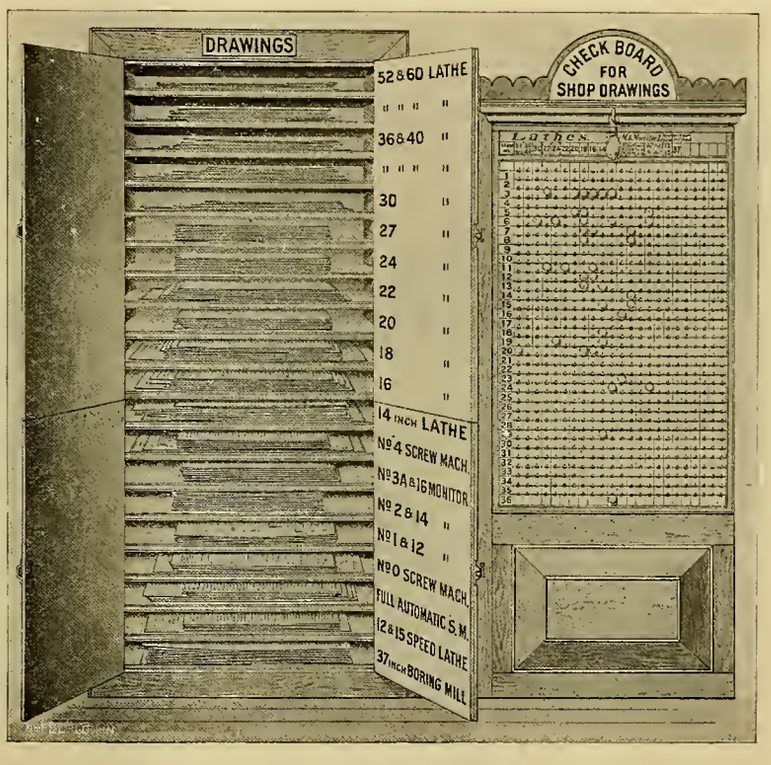
Kokomo, August 9.—In the last heavy storm that struck this region lightning hit a large oak tree, on the farm of Jacob Somsel, near Galveston. Under the tree at the time were 91 sheep and 50 chickens. Thirteen of the sheep were killed, and the remainder were struck blind, many of them injuring themselves in fleeing from the tree. The chickens that had taken shelter in the hollow of the huge oak were also blinded by the bolt.

Lightning Causes Explosion.

Buffalo, N. Y., August 19.—Lightning struck a powder and dynamite magazine at Port Colborne, Canada, at 5:30 o'clock this morning, and the explosion was so terrific that it acted like an earthquake for 20 miles on each side of the lake. The shock was distinctly felt in Buffalo. The magazine contained half a ton of dynamite and many hundred pounds of powder. The building was built half way in the bed rock. Near by stood the glass factory owned by the Hamilton glass syndicate. It was completely demolished. The nearest person to the scene of the explosion was James Horne a watchman. He was knocked off his feet by the concussion, but was not injured. All the windows in Port Colborne were broken, mirrors fell off walls, china was broken and furniture jumped about the rooms. The explosion was followed in a few minutes by a severe thunderstorm.

System of Shop Drawings.

The accompanying illustration shows a new system of shop drawings, as used by the Davis & Egan Machine Tool company of Cincinnati. The drawings are all made to one or the other of two standard sizes, 19 by 13 and 19 by 26. They are mounted on galvanized iron, having the ends and sides turned over so as to preserve the edges and lend additional stiffness. They are placed in the drawing cupboard, shown in cut. Directly opposite each shelf, on the door, appears the name of the machine which the drawings represent.



SYSTEM OF SHOP DRAWINGS.

Accompanying each set of drawings is an index sheet, giving the number of each detail sheet, and duplicates of this index are hung in convenient places throughout the works.

In combination with the cupboard is a checkboard, shown at the right. At the top of this checkboard is the name and size of each machine for which there are drawings in the cupboard. At the right-hand side of the checkboard appear the numbers of the detail drawings.

When a workman in any department wants a drawing, he consults his index, and obtains the number of the drawing wanted. He then sends a bell-boy to the main tool room where the drawings are kept, secures the drawing and leaves the workman's check, which is then hung directly under the name of the machine and opposite the number of the detail sheet, so that a glance at the checkboard readily shows the number of drawings in use in the works and just what workmen have them.

The Carrollton Railroad company, it is reported, has arranged to build its proposed extension in the city of New Orleans and suburbs.

American Electrical Works Nineteenth Annual Clam Dinner.

As each year has passed along since the first clambake was given by the American Electrical Works until they have now counted up nineteen, it is needless to say that they have not passed without changes from year to year in the personnel of the gatherings. Some have moved from the vicinity where they could attend, others have entered other lines of business, and many have passed away. But the high standard originally adopted for these clambakes has always caused the participants to say that each succeeding year was better than the one before, and so again it is heard on all sides from the large number gathered at Providence on August 21st to partake of the hospitality extended by President Eugene F. Phillips. It is the same old story that this year exceeded all others in its general good time.

As usual, the party, to the number of about 300, gathered in the morning at the Narragansett Hotel, from which point special trolley cars were run down the bay to the Pomham club, where arrangements had been made for the usual games and sports, consisting of baseball, shooting, quoits and bowling. Lunch was served at 11 o'clock, after which the photograph was taken from which the cut shown herewith was made.

About three o'clock the guests were invited to take their places in a large tent to partake of the celebrated clambake for which the American Electrical Works are noted. After discussing a menu which surpassed any previous effort of the chef of the Pomham club, President Phillips in a few graceful and complimentary remarks to those present called upon Samuel L. Powers to act as toastmaster and the latter introduced Mayor McGuinness of Providence, who presented the freedom of the city to the visitors. George R. Stetson was called upon to respond to the toast, "The National Electric Light Association," and he took occasion to impress his hearers with many facts relating to the great benefit that the association had been to the electrical fraternity, and the prominent place which the American Electrical Works had always held in the estimation of that society. Samuel A. Duncan made a few remarks in regard to the Postal Telegraph. R. F. Ross spoke for the "Electrical Press." A few pleasant words were spoken by H. F. Wood of the West End Railway company of Boston, and the Hon. John C. Wyman kept the audience in the best of humor enjoying the many anecdotes that he had to relate, sometimes at the expense of those present.

It was noted that there were two gentlemen present who had attended every clambake of the American Electrical Works—Frank Ridlon and Stephen E. Field.

Delightful music was furnished during the day by an orchestra, and souvenirs of beautiful sterling silver-headed canes were presented to those in attendance.

Death of Edward L. French.

Edward L. French of the American Electric Telephone company of Chicago died suddenly on August 21st in St. Vincent's Hospital in Toledo, O. On August 11th Mr. French, who was but 26 years of age, met with an accident at Put-in-Bay, which caused spinal injury. He was removed to the hospital in Toledo, and there suffered a fatal shock of paralysis. The young man was the general salesman of the company and was highly esteemed. In a brief tribute, Mr. H. C. Dodge, the general manager of the American Electric Telephone company, has this to say of Mr. French: "Possessing a fund of good nature, originality and wit, always cheerful and cheering, looking on the bright side of life and challenging defeat, animated by generous impulses, manfully aggressive and courageous, with much tenacity of purpose and a fine sense of justice, he was well equipped to fight life's battle, mentally and physically. He was proficient in all manly sports, of charming manner and courteous bearing—a friend worth possessing and an enemy not to be despised."

Public Lighting in Buffalo.

Not the least important preparation for the reception of the Grand Army men in Buffalo was the lighting of Main, Seneca and Exchange streets, which had been specially arranged for the occasion. The work of putting in the new arc lamps on Main street was completed last Saturday. The Welcome arch at Main and Niagara streets was fitted with 2,000 eight candle power lamps, and the Triumphal arch was illuminated with searchlights from neighboring buildings. The General Electric company of Buffalo, which furnished the numerous electrical devices about the city, exhibited a very attractive and appropriate design in front of its building on Court street, comprising a waving flag containing 2,100 incandescent lamps in red, white and blue. The enterprise displayed by the company in arranging the street lamps was the subject of much favorable comment. The Buffalo Evening News says:

"The Buffalo General Electric company certainly is entitled to great credit for this work. The appearance of Main, Seneca and Exchange streets under the glow of the new street lights at night would be creditable to any city in the world. The work of laying the conduits for the new lights was done in 75 days and so skillfully that traffic was not interfered with and the people scarcely knew that the streets had been torn up. There are 220 new lights in the streets and the parks under the new system. On Main street, from the docks to Tupper street, there are 152; in Exchange street, 24; in Seneca street, 24, and in the parks 20. The lights are each 2,000 candle power and are placed 100 feet apart, being set diagonally across the street. The underground work was all done by the J. G. White company of New York. The electric work was done by H. G. Stott, the electrician for the General Electric company. The cables were made by the Safety Insulated Wire and Cable company of New York. The poles, which are an ornament to the city, were made by J. P. Cullen & Co. of Buffalo and Morris, Tasker & Co. of Philadelphia. The manholes were constructed by Bingham & Taylor of Buffalo.

"The General Electric company has taken great pride in this work and may well feel that it has contributed a great deal to the fine appearance of the city. Charles R. Huntley, the general manager of the company, is also entitled to a great deal of credit for the work he has done as chairman of the G. A. R. committee on illuminations and decorations."

English Messenger Boys Under Arms.

Grim-visaged war must haunt the visions of loyal Britons in this year of grace 1897, for not only are the peaceful electricians incited to join the Volunteers, but even the messenger boys have been armed and drilled as a military corps. The fact seems really remarkable, but the statement is made on the respectable authority of the London Electrician, which, in a recent issue, said: "More than 1,000 messenger lads in the employ of the postal authorities who have been drilled and armed as a Volunteer corps, were inspected in Hyde Park last week by Major-general Lord Methuen. It is stated that about one-third of the metropolitan telegraph messengers are members of the corps. Lord Methuen expressed his gratification at the soldierly bearing of the lads."

AMERICAN ELECTRICAL WORKS NINETEENTH ANNUAL CLAM DINNER.

Association of Edison Illuminating Companies.

The annual convention of the Edison association will take place at the Cataract House, Niagara Falls, on September 14th, 15th and 16th. The programme is about completed and, it is believed, will prove highly attractive.

CORRESPONDENCE.

New York Notes.

New York, August 24.—Municipal ownership is to be an issue in the coming city campaign, if some of the labor men can make it so. A meeting was held one evening last week under the auspices of the Knights of Labor to advocate the municipal ownership of public franchises. The hall was well filled, it is said, and the views of the speakers were enthusiastically received. The speakers were Michael Fitzgerald, ex-master workman of District Assembly No. 49, Knights of Labor, who presided; William Hepburn Russell and Thaddeus B. Wakeman. All advocated municipal ownership and urged that it should be an issue in the coming city campaign. Resolutions in favor of it and denouncing the city officials for not re-acquiring the Sixth and Eighth avenue railroad franchises were adopted. Letters of regret were received from the Rev. Dr. McGlynn, Judge Gaynor and Mirabeau L. Towns.

The daily papers relate another instance of fatal carelessness in an electric light station, and that on the part of an experienced man. Over-confidence resulted in the death of George Leuthhauser of Brooklyn, who was the head electrician for the company supplying current to the Annexed District. He was shutting down some machines on Wednesday morning when he met death. One account states that "One of the switchboards is directly over a dynamo, and Leuthhauser had time and again vaulted on top of the machine to reach the lever. With the carelessness born of custom he stepped on the dynamo yesterday morning, but by some fatal mischance he slipped. He had his hand on the lever of the switchboard, and as he slipped he instinctively threw out his other hand. The convulsive effort to save himself from hurt cost him his life. The outstretched hand rested on the field of the dynamo, and Leuthhauser fell, a lifeless mass, to the ground. The 2,000 volts generated by the dynamo had entered his body. The sound of the falling body as it struck the stone flooring attracted the attention of the engineers and stokers in the power-house, and they rushed to the spot. One glance was sufficient to convince them that the master electrician was beyond the power of human help. A scar in the palm of his hand and burns on the finger-tips showed where the fatal fluid had entered." This account is not as precise as might be desired, but it shows very clearly that the man brought his death upon himself by imprudence. The lesson of it is a repetition of the old warning to treat high-voltage machines and conductors with respect, no matter how familiar they have become by long association.

A meeting of the stockholders of the Metropolitan Traction company has been called for September 14th, to vote on a proposition to wind up the company. The explanation is made in a circular, signed by the president, H. H. Vreeland, that the purposes for which the company was formed have been accomplished. The object of the company was to secure and bring together street railway lines. The circular says: "The combined property is directly represented by the capital stock of the Metropolitan Street Railway company, now in the hands of the Traction company. The stockholders of the Traction company are the real owners. There seems to be no reason why these owners should not now receive the stock which directly represents their property, and at the same time be relieved from the now unnecessary burden of double administration and very heavy double taxation." There is $30,000,000 of Metropolitan Street Railway stock and $6,000,000 of other stocks and bonds in the company's treasury. Traction company stockholders will receive for their holdings an equal amount of Metropolitan Street Railway stock and 20 per cent. in other securities.

The State Board of Railroad Commissioners at Albany has granted the application of the Second Avenue Railroad company of this city for permission to change its motive power to the underground electric trolley system. The board has also granted an application of the Forty-second Street and St. Nicholas Avenue Railroad company of New York city to substitute the underground electric trolley system for the present motive power. This company asked to be allowed to adopt either the underground electric trolley or the compressed-air system. The board did not consider the last part of the application, saying it does not desire at this time to pass upon the compressed-air system as a method of motive power. The board has approved the application of the Ocean Electric Railway company to construct a surface road to Far Rockaway. A condition of the application is that the road shall not be constructed at grade across the Long Island railroad at Hollywood and Carnaga avenues, but may be constructed at grade on Wait avenue.

The Hardie compressed-air motor was operated on the Sixth Avenue "L" road last week. It pulled a train of four cars with 192 passengers from Rector street to Fifty-eighth street and back to Cortlandt street. The up trip was quickly and easily made, but coming down town there were several stops, and the time was not so good. The air-compressing plant is at 100 Greenwich street. From this point the air passes in a pipe to the water station on the elevated road near Rector street. When the engine is to be charged a connection is made with this pipe and the air passes into a stack of steel tubes concealed in a boiler-like jacket, which receive it at a pressure of 2,500 pounds to the inch. It is said that a charge which will run a train to Fifty-eighth street and back can be taken on in the same time it usually takes to receive the water for a trip. In relation to the trip General Manager Fransioli is reported to have said: "It would be unfair to say much about the motor. The trip last night was by no means a test trip. There were only four cars and less than 200 passengers. There were no grades, and the conditions were all favorable for any kind of a feasible motor. The engine ran very smoothly and made the up trip, where there were no stops, in much quicker time than the down trip, where there were several stops. In order to ascertain the practicability and feasibility of a motor, it must first be subjected to all kinds of rigorous tests, such as severe weather, changes in tracks, steep grades and unusually large loads. The pneumatic motor exhibited last night did not differ much from the pneumatic motor exhibited several years ago."

The contracts between the trustees of the Brooklyn Bridge and the owners of the two elevated railroads and the principal trolley lines in Brooklyn, under which cars of both kinds are to be run over the bridge to the New York terminus, were signed yesterday. There seems now to be no reason to doubt, says the Sun, that within six months one will be able to take a trolley car for any part of Brooklyn at this end of the bridge, and that within a year the same will be true of the elevated trains. The bridge fare in each case will be eliminated, and the entire ride over any one of the various lines in question will cost but five cents. The contracts require that the trolley roads shall begin the work of altering the bridge for their purposes within 10 days and complete the work within six months. The Brooklyn Elevated is to begin its work within 60 days and be ready to operate across the bridge within 10 months, and the Kings County road has a year within which it shall be ready to operate. The roads are to pay the cost of all alterations on the bridge. Those to be made by the elevated roads will be insignificant and consist principally of a Long Island platform to be erected between the tail tracks in the New York terminal and of stairways to reach this. The Brooklyn City road will have the use of this platform, while the Kings County trains will alternate with the bridge cars in using the present platforms. The elevated roads have got to do a great deal of work besides this. They must both provide all of their cars which are to cross the bridge with cable grips, and they must build out their car platforms three inches on a side, to the width of the bridge cars and cut off their own station platforms the same amount. The Brooklyn City road will also change its motive power along the whole line to electricity, and for all purposes, Mr. Uhlman says, it will be obliged to spend $1,250,000 to $1,500,000. The Kings County road will probably make no general changes of this sort, but will make an arrangement with the bridge people to furnish electric motors to shifts its trains to and off the bridge. M. S.

New England News.

Boston, August 24.—The members of the Fire Department of this city are fast becoming students of electricity. Some time ago it was deemed advisable to instruct the firemen in regard to electrical appliances, and, after a conference with the fire commissioner, the Wire Department installed specimens of transformers, switches, fuse boxes, hanger-boards for arc lamps, and all appliances that might be necessary for the firemen to understand in case of fire. At the Fire Department headquarters a school of instruction in electricity has been established, and Wire Commissioner Flood is of the opinion that both firemen and policemen should be familiar with the use of various electrical appliances of modern life. Electrician Brophy has been detailed by Commissioner Flood to instruct Drillmaster Kinney, who in turn is to instruct his several classes how to operate and handle the various electrical appliances.

At a meeting of the stockholders of the Vermont and Boston Telegraph company, held at White River Junction, the following-named were chosen directors: Thomas T. Eckert, John Van Horne, Roswell H. Rochester, Charles A. Tinker of New York; Thomas Roche and Henry C. Sherman of Boston; Robert J. Kimball of West Randolph and Charles W. Smith and Henry E. Tinker of White River Junction. Thomas T. Eckert was chosen president and Charles A. Tinker vice-president, Thomas T. Eckert, Charles A. Tinker and John Van Horne executive committee.

Henry B. Cutter, the Philadelphia electrician, who has been in Boston looking into electrical matters, called upon Commissioner Flood and Chief Electrician Brophy, and stated to them that in his opinion the department was as near perfection on electrical lines as one could desire.

Chief Electrician Brophy has been requested to prepare a paper on "Modern Construction and Maintenance of Electric Wires of Municipalities," to be read at the September annual meeting of the International Association of Fire and Police Telegraph Superintendents, to be held at Nashville, Tenn.

Stephen M. Canty of Hartford, an electrician, was found dead at the residence of his brother-in-law in that city recently, death having resulted from heart failure, brought on by excessive smoking. He was 36 years of age, and was well known as an electrical expert, especially in Connecticut and New York. He was the inventor of a storage battery bicycle lamp and of a telephone bell. He leaves a widow and a daughter in Hartford.

The electric street railway lines are becoming an important factor in the tourist business. It is understood that Raymond & Whitcomb have for some time been using the cars of the West End Street Railway company instead of coaches in showing the patrons of excursions the sights of Boston. It is generally conceded by those who are familiar with both methods that they experience more real pleasure in looking over the city from an open street car than they do from a slow-moving carriage, that affords no protection from the sun and limits the range of vision dead ahead. The plan is to put no more than three persons on a seat, and divide the group into two parties, assigning to each a lady who is perfectly familiar with all the prominent buildings and the various historical localities.

The electrical workers of this city have begun preparations for a better organization of the trade, in the hope of establishing a higher standard of workmanship and uniform wages. At a meeting held in this city recently, under the auspices of Electrical Workers' Union No. 35, it was voted that all union electricians should demand the following schedule of hours and wages: Eight hours shall constitute a day's work; time and a half for overtime; a first-class man shall be capable of doing all kinds of work appertaining to electrical construction in his class in a workmanlike manner; his wages shall not be less than $3 per day, and when selected to take charge of the work as foreman, with three or four men under him, he shall receive not less than $3.50 per day; a second-class man must be able to do work when so directed in a workmanlike manner, and his wages shall not be less than $2.50 per day. It was decided that an apprenticeship system was also necessary, and in accordance with this decision rules were adopted which provided, among other things, that an apprentice shall not be allowed to finish work in any branch of the trade under two years' service, when he shall be examined by an examining board.

The New England Telephone company is attempting an experiment of underground telephone service on Beacon street in this city. It is only an experiment, and will not be tried in any other part of the city. The cables are laid in wooden boxes, and are covered with pitch, which protects the insulation. The experiment will be tried on the water side of Beacon street and will be completed in about three weeks.

Committees representing the West End Street Railway company and the Boston Elevated Railroad company are in constant consultation drawing up the lease of the West End to the Elevated company. The lease will probably be in shape for presentation to the stockholders of the West End within a week or 10 days. The directors that are drawing the lease are Messrs. Rogers, Gaston and Winsor for the Elevated company, with Gaston & Snow as counsel, and Messrs. Coolidge, Russell and Weld for the West End company, with ex-Attorney-general Richard C. Olney as counsel.

The Board of Harbor and Land Commissioners has received a petition from the People's Telephone company of Haverhill for permission to lay cables across drawbridge channels of the Merrimac River between Haverhill and Bradford and Groveland, in tidewater of the Merrimac River. C. S. G.

Washington, D. C.

Washington, August 24.—The District commissioners have refused the request of John A. Hughes for permission to operate a horseless wagon through the streets of Washington. In refusing the request the commissioners state that experience with similar vehicles has shown that they cause much serious danger by frightening horses, and that several runaways and accidents resulted on the trial trip of a similar vehicle a short time ago. The vehicle referred to above was to have been used by Mr. Hughes as a delivery wagon in connection with his business. It is propelled by a gasoline motor and makes a puffing noise while running, having about the same effect on nervous horses as does a steam street roller.

Bids have been opened in the office of the architect of the capitol for a new elevator to replace the one now in use at the end of the west corridor on the Senate side. This elevator is the one set aside exclusively for the use of the Senate during the session and is a very slow, old-fashioned affair. Congress at the last session made an appropriation to replace it with a more modern elevator. Two bids were received, one from the Sprague Electric Elevator company of New York and one from the Otis Elevator company. The bid from the Sprague company was $3,685 for a modern elevator of 4,500 pounds capacity, constructed so that the speed may be regulated anywhere between one foot a minute and 250 feet a minute. This was the lower bid and will probably be accepted. The Otis bid was $4,220 for a hydraulic elevator and $4,370 for an electric elevator.

In the last few months the District commissioners have received many requests from persons living in the resident portions of the city, regarding street arc lights, the majority of the requests being for the shading of the globes so that the glare of the

light will not fall on certain residences, and in some cases requests have been made for the entire removal of the lamps. To offset this there have been but few applications to have lamps put up. The numerous requests for shading globes are doubtless due to the season, for in the warm weather a great many persons desire to sit in their yards or on their stoops, and find it unpleasant with the rays of a 2,000 candle power lamp glaring them in the face. The lamp that has been practically unnoticed all winter then becomes a source of complaint. Sometimes it is the resident in front of whose premises the lamp is situated, while again it may be from his next-door neighbor or the one across the street, or, sometimes, from one half way down the block. Most of the requests are simply for the shading of a part of the globe. Often the person making the request offers to pay the cost, but again a request comes for the immediate removal of a light which is declared to be a nuisance. All sorts of devices are resorted to to get rid of the rays, and the latest request that has reached the commissioners is from a resident of the fashionable part of the city who wants to erect a canvas screen, a huge sail-like affair, to keep out the light. This request was refused. Many have secured awnings and curtains for their porches to screen off the light, and it is no uncommon thing to see parties sitting on their stoops late at night protected by upraised parasols.

Acting Secretary Meiklejohn of the War Department has prepared and will issue new certificates of honor under the act of Congress granting such certificates to telegraphers who served in the late war. The first certificates were prepared hastily and were unsatisfactory, as they designated as operators only those connected with the Quartermaster's Department, when the act provided that it was to be granted to all telegraphers who served during the war. It is estimated that there are about 150 actual telegraphers, but the act will include all others connected with the telegraph service during the war. There were 23 of the first certificates sent out, but the asistant secretary ordered them to be returned, and so far 18 have been received. As soon as the new certificates can be engraved they will be issued to those entitled to them.

Postmaster-general Gary is now in direct communication by long-distance telephone with the principal cities east and west. The circuit extends from Bangor, Me., to St. Paul and St. Louis. The department will use this service to communicate with postmasters, inspectors and other officials.

The Treasury Department is to have a complete system of telephone exchange. The Chesapeake and Potomac Telephone company has been awarded the contract at a cost of $2,262.50. The system is to include 45 stations, 39 of which will be in the Treasury Department. The remaining six will be distributed, one each for the Marine Hospital, the office of the auditor for the Postoffice Department, the Bureau of Statistics, the office of the auditor for the War Department, the treasury stables and the secretary's private residence. Instruments are to be placed on the desks of the secretary and three assistants and all chiefs of bureaus. It will be necessary to have a switchboard in the department. The Bell system will be used, and the instruments will be metallic circuit, long-distance telephones, except in cases where the chief will prefer not to have the long-distance attachment. T. I. P.

PERSONAL.

A. C. Garrison, secretary and treasurer of the Columbia Incandescent Lamp company, St. Louis, was a Chicago visitor this week.

Charles Holmes, purchasing agent of the Chicago Edison company, accompanied by his wife and family, is enjoying a well earned vacation at Fox Lake, Ill., where he will in all probability remain until the first of September.

Eastern electrical circles are exercised over the fact that Prof. A. E. Dolbear of Tufts College has seen the ghost of Moses G. Farmer, who died in Chicago during the World's Fair. Perhaps it was a dream, but if so, the professor thinks it was a very strange dream.

The sudden death on August 7th of one of the most promising electricians of the country, George R. Lean of Cleveland, is announced. Mr. Lean, at the time of his death, was superintendent of the Buckeye Electric company and also of the Jandus Electric company. He had held these positions for some years, and during that time made several notable inventions connected with the design and manufacture of arc and incandescent lamps. Mr. Lean was 35 years old, and died very suddenly after an operation for appendicitis. Altogether he was ill but five days, and this sudden and untimely end of one so young and promising has been a great shock to his associates, as it will also be to the many friends he had in the electrical fraternity.

ELECTRIC LIGHTING.

The city of Hannibal, Mo., is in the market for a second-hand Corliss engine, 400 or 500 horse power, right-hand and 24 by 48, to be used in electric light plant. R. H. Womack, city clerk, should be addressed.

The Electric Lighting company of Mobile, Ala., is making arrangements to duplicate the present capacity of its plant, putting in new boilers of 500 horse power, new engines of 400 horse power and five new dynamos.

The Town Council of Donaldsonville, La., has engaged George U. Borde of New Orleans to prepare plans and specifications for the contemplated water and electric light works.

The contract for erection of the electric light plant and the construction of water works at Lafayette, La., has been transferred by J. M. Ferguson, the orginal contractor, to the Consolidated Engineering company of New Orleans.

The City Council of Joliet, Ill., the Economy Light and Power company and several prominent business men along Jefferson street are involved in an interesting controversy, which grew out of an order by the council that the electric light poles be set back off the street, thus making it necessary to cut into the sidewalks. The business men objected and threatened to arrest the electric light employes. The latter kept on and then the courts were appealed to. Injunctions have been issued and there will be a judicial hearing before any more poles are set.

The correspondent of an English paper states that one of the most important and probably remunerative concessions that has been granted in Siam for some time past has been signed at Bangkok by the minister of finance. The concesion in question grants to L. E. Bennett, an American engineer, the exclusive right to work the concern known as the Siam Electric Light, for a period of 10 years, with the option of holding the concession and all exclusive rights for an additional 10 years at Mr. Bennett's pleasure. The terms of the contract give Mr. Bennett the exclusive right to light Bangkok and suburbs, the latter term being somewhat vaguely extensive. A local company has been formed with a capital of 100,000 ticals (about $50,000) to make necessary repairs and alterations and increase the efficiency of the concern. This sum was promptly taken up in a few hours by a few local business people, and, judging by the eagerness to obtain shares of 1,000 ticals each, 10 times that sum might have been covered locally.

ELECTRIC RAILWAYS.

The Knoxville (Tenn.) Street Railroad company proposes to build an extension in North Knoxville to be operated by electrical power.

It is stated that the Sprague multiple-unit system of electric traction will be further tested on the Alley "L" road of Chicago, under actual conditions of service, late in October. So far only favorable results are reported.

Messrs. Meliss of New York, lawyers and engineers, have made a contract with the city of Caracas, Venezuela, by which they will establish an electric light, heat and power company. They will utilize the power from the waterfalls of Macuto.

A continuous trolley line is projected for the west side of the Connecticut River, connecting the cities of Springfield and Hartford. The Southwestern Trolley company has secured a charter to build the road, and has given assurances that it will be completed by the first of November.

When work on the construction of the trolley lines between New Brunswick and Bound Brook was begun at Bound Brook, N. J., last week, the road was christened with a bottle of champagne by Edward H. Radel, the superintendent and secretary of the Brunswick Traction company.

It is stated that the Wheeling (W. Va.) and Elm Grove Railroad company is about ready to let contracts for the construction of its electric line. The road is to be laid with 90 pound rails, and within the city limits will be 2½ miles long. Brown & Hazlett, engineers, at Wheeling, are in charge.

The Staten Island Electric Railroad company began the operation of a new line from Port Richmond to Bull's Head on Sunday, August 22d. The new branch is about three miles long, and was built in 10 days. The last rail was laid at nine o'clock Saturday evening, and a special illuminated car filled with Staten Island officials was run over the line. Along the route citizens greeted the opening of the line with displays of fireworks.

Syracuse, N. Y., is a town in which visitors noticed the high rate of speed of the trolley cars. For a time the cars were allowed to be operated at the rate of 15 miles an hour anywhere outside of a circle in the central part of the city which had a half-mile radius. Now, however, the Common Council has revoked the ordinance giving this permission, and the rate of speed must not exceed eight miles in the city.

Proceedings were begun at Milwaukee to invalidate the street railway franchise granted the Milwaukee and Waukesha Electric Railway company by the Milwaukee Common Council. The complainant claims that the city charter provides that an ordinance to grant a franchise must be published for two weeks prior to its final passage, and as the Milwaukee and Waukesha Electric Railway company franchise was amended at the council meeting at which it was finally adopted, it is claimed, this enactment was illegal, as the amended ordinance became a new measure and could not be legally adopted until after its publication as amended for two weeks.

TELEGRAPH.

Arrangements have been completed with the two great railway systems of the Republic of Mexico, the Mexican National railway and the Mexican Central, by which the telegraph lines have passed under the control of the Postal Telegraph-cable company. The Postal company thus secures a continuous system from the United States to all the principal cities in the neighboring republic. As a consequence of the extension, it is claimed, the message tolls from American cities have been reduced 40 per cent.

Lieutenant Squier of the artillery school at Fortress Monroe, Va., and Prof. Crehore of Dartmouth made some demonstrations of the possibilities of the synchronograph in England last week. The government telegraph officials gave the inventors the use of a clear line, 860 miles long, making a circuit through London, Leeds, Glasgow, Edinburgh, Newcastle, York and other places, over which the Americans succeeded in transmitting short messages at a speed equivalent to 4,000 words per minute. The messages were received with perfect clearness. Forty-four miles of the line was underground.

TELEPHONE.

William Jennings Bryan delivered an address on "Bimetallism" at Rapid City, S. D., August 24th. The Black Hills Telephone company had placed a phonographic attachment in front of the speaker, and his words were reproduced and telephoned over the entire circuit of the Hills.

The Maryland Telephone company has been incorporated by Claude M. Acklen, Ira H. Gaither, Chas. C. Richardson, R. B. Hazlett and Charles E. Fink, for the purpose of manufacturing electrical apparatus and equipping lines for the use of telephones and other purposes. The capital stock is $200,000.

The Interstate Telephone and Electric company of Dubuque, Iowa, has been organized to establish a local exchange in opposition to the Bell company. It announces that all stock has been subscribed and that work will be begun at once. F. F. Sapp of Chicago is president and E. T. Keim of Dubuque secretary. The capital is $100,000.

MISCELLANEOUS.

It is stated that a large electric power plant for the shops of the Georgia railroad is to be erected at Augusta, Ga.

The Chicago Tribune says that Mrs. Frances Shaw of Irving Park, Chicago, has invented a new enamel that has wonderful heat-resisting properties. If all that is claimed for the invention is true, Mrs. Shaw should have something of great interest to the manufacturers of electric heating and cooking utensils.

On August 25th City Electrician Ellicott opened bids for the repair work on the city electrical apparatus. The contract amounts to about $30,000, and was made necessary by the closing of the city repair shops. The contract will not be awarded until the mayor returns home. The Pioneer Electric company was the lowest bidder. It offered to repair police signal boxes for $1.75. The Western Electric company bid $2.50 for the same work. The Pioneer company offered to repair arc lamps for $2.35, while the Western Electric company bid from $6.50 to $8.

"What is an E. L. E.?" asks the London Electrical Review. "We have occasionally seen the appendage 'Ass.,' etc., to a name, and have more than once quite pardonably, nodded approval; but when a gentleman's card is put before us, Mr. ——, E. L. E., we must confess to something more than a nod. We are non-plussed, for E. L. E. might mean so many things. But perhaps it is, after all, only an attempt to dub oneself an electric light engineer in an imposing manner. A correspondent, who sends us a card decorated in this way, suggests that, perhaps 'E. L. E. is a new degree or a Jubilee honor.'"

A. Blondel, in some recently published observations on the nature of the electric arc, concludes that it has now been definitely established that the electric arc behaves as a resistance, and does not offer any back electromotive force comparable to the observed difference of potential at the terminals. The phnomena are also not due to electrolysis. With the degree of accuracy obtainable the experiments determined that if a residual counter electromotive force should exist due to thermo-electric effect, it would not exceed a fracton of a volt, and that finally the arc is equivalent to a resistance, but up to the present the nature of the resistance has not been determined.

Lord Kelvin is disposed to make great account of mathematics in the advancement of the sciences. The possibility of a metaphysician undervaluing mathematics, he says, has always seemed to him one of the greatest marvels of contradiction, which that very wonderful phenomenon in matter, the human mind, can develop. Of all classes of thinkers, he declares, the metaphysical class is the one that ought to pay homage to mathematics. And

yet, says the Chicago Tribune, in the signally important contributions both to pure science and to applied science made by Lord Kelvin himself, his genius for mathematics would have made but small headway without the "proleptic glance," the forecasting lead of the imagination.

A recent amendment to rule 17 of the Rules of Practice of the United States Patent Office contains the announcement that a register of attorneys will be kept "on which will be entered the names of all persons entitled to represent applicants before the Patent Office in the presentation and prosecution of applications for patent." The amended rule recites at length the qualifications of the persons entitled to registry and makes provision for the limited recognition, for a certain specified application, in the discretion of the commissioner, of persons or firms not registered. Otherwise, "after January 1, 1898, no person not registered in accordance with this rule will be permitted to prosecute applications before the Patent Office." Inventors should, therefore, employ none but registered patent attorneys. A simple application to the commissioner of patents will secure for the applicant the knowledge of his attorney's registry status with the department.

An attempt will be made, it is said, to transmit an electrical message without wires by the utilizing of ether currents within two weeks. The experiment, if the plans meet with no check, will take place Labor Day, September 6th. Two kites carrying copper wire will be used. Silas Conyne, who will undertake the experiment, will not give out all the details. He says they are not yet entirely settled. It is, however, provided that one station will be at Humboldt Park, Chicago, and the other at River Grove, Ill. At each station a kite, connected at the ground with the delicate instruments prepared for the purpose, will be sent into the air a quarter of a mile. It is the inventor's belief that when a particular current is reached the electricity generated at one end will be discharged, will transmit itself to the ether current, and will be transferred to the other kite 20 miles away. Mr. Conyne says: "There can be no question that at some time the experiment will be a success. How soon only the experiment itself can prove. The air is full of currents along which electricity may be transmitted as readily as though they were sheets of copper; the problem before electricians is to construct such instruments that the currents or sheets of air can be utilized. Our instruments are now in course of preparation. I do not care to say where, but at a well-known manufactory of electrical goods in Chicago. They will be completed very shortly and then we will make the experiment. It is my judgment that for communication of messages 100 miles not more than 1,000 feet of altitude would be absolutely necessary, but it is as easy to put the kites we shall use 3,000 feet into the air as it is 1,000."

ELECTRICAL SECURITIES.

The first consolidated mortgage gold bonds of the Edison Electric Illuminating company of New York, due September 1st, will be paid on and after that date by the Guaranty Trust company of New York.

The New England Telephone and Telegraph company offers 10,395 shares of the capital stock, now remaining unsold in the treasury, to stockholders for cash at par in proportion to their respective holdings.

Enough Siemens & Halske stock has accepted the proposition of merging with the Pennsylvania Iron company to assure the success of the consolidation. For the present there will be no change in the corporate forms of the two companies—that is, the Siemens & Halske Electric company of America will continue just as before, the Pennsylvania company holding that portion of its capital stock which has been exchanged for Pennsylvania Iron stock.

The United Electric Securities company's profit and loss account for six months ended August 1st shows: Underlying bond interest and dividends received, $167,023; collateral trust bond interest and expenses, $119,813; net profit, $47,210; profit from sale of underlying bonds and purchase of Collateral Trust 5's, $40,195; total six months' gain, $87,405; surplus February 1, 1897, $6,808; charged off, $50,672; surplus August 2, 1897, $43,541.

In the way of earnings the showing of the Metropolitan Street Railway company of Kansas City for the month of July is much better than that for the previous month. A comparative statement for the month of July, 1896 and 1897, is as follows: Gross earnings, 1896, $163,184.55; 1897, $168,986.49; increase, $5,801.94; operating expenses, 1896, $91,513.44, 1897, $92,473.70; increase, $960.26; net earnings, 1896, $71,671.11; 1897, $76,512.79; increase, $4,841.68; total interest charges for month of July, 1897, $45,065.17; net surplus for month of July, 1897, $31,447.62. In June the net earnings of the system showed a decrease of $248 as compared with June, 1896.

The semi-annual report of the Cuba Submarine Telegraph company announces that the gross receipts amounted to £25,623 14s. 7d., and the gross expenditure to £7,005 15s. 1d., leaving £18,617 19s. 6d., which added, to the balance brought forward, leaves £21,717 9s. to the credit of revenue. The traffic receipts show a decrease of £10,854 19s. 11d., when compared with the corresponding period of last year, the falling off being chiefly due to the loss of the French company's traffic. Dividend on the preference shares absorbed £3,000, leaving £9,717 9s., out of which the directors recommend the payment of a dividend on the ordinary shares at the rate of eight per cent. per annum free of income tax.

The Brooklyn Heights Railroad company and the Brooklyn, Queens County and Suburban Railroad company, which are owned by the Brooklyn Rapid Transit company, have completed their annual reports and issued the following statements:

Brooklyn Heights Railroad Company—Gross earnings (1897), $4,392,298; (1896), $4,272,392. Operating expenses (1897), $2,617,738; (1896), $2,503,226. Net earnings (1897), $1,774,560; (1896), $1,769,166. Other income (1897) $238,298; (1896), $232,599. Total income (1897), $2,012,858; (1896), $2,001,765. Taxes and charges (1897), $1,900,365; (1896), $2,044,875. Surplus (1897), $112,493; (1896), deficiency, $43,109.

About $22,000 of track rentals, which in 1896 were charged to fixed charges, were last year charged to operating expenses. The balance sheet shows that the company has no floating debt, as against bills payable on June 30, 1896, of $349,546.

Brooklyn, Queens County and Suburban Railroad Company—Gross earnings (1897), $730,276; (1896), $684,946. Operating expenses (1897), $437,502; (1896), $451,130. Net earnings (1897), $292 774; (1896), $233,816. Other income (1897), $9,382; (1896), $18,017. Total income (1897), $302,156; (1896), $251,833. Taxes and charges (1897), $357,272; (1896), $345,561. Deficit (1897), $55,116; (1896), $93,728.

The Brooklyn Rapid Transit company owns the capital stock of the Brooklyn Heights and Brooklyn, Queens County and Suburban Railroad companies and has outstanding bonds of $5,511,000, leaving $1,489,000 in its treasury. The Brooklyn Heights company contributes over $160,000 a year toward meeting the interest on these bonds, this amount being the interest on the construction advances to the Heights company by the Rapid Transit company, which are included in the Heights company's fixed charges, mentioned in its statement. In addition the Brooklyn Rapid Transit company receives over $100,000 a year in interest upon securities held and funds invested, and is entitled to all the surplus profits of the two operating companies.

TRADE NEWS.

The Missouri Telephone Manufacturing company of St. Louis has recently taken a number of exchange contracts which will crowd the factory to its utmost capacity. A visit to the company's works will conclusively prove that business with it is booming.

Walter C. McKinlock of Chicago has been appointer general western selling agent for the Maxstadt combination double-pole porcelain fusible cut-out lightning arrester, to represent the American Electric Fuse company. Mr. McKinlock's office is in the Fort Dearborn building.

The Ball & Wood company of New York has issued a handsome catalogue of its engines. It builds simple and compound horizontal engines of all the usual sizes in tandem, cross-compound and vertical arrangement. All useful details and dimensions are given, with well executed pictures, and the work should be a good reference book for engineers.

The Brush Electric company has lately made the final shipments of manufactured and raw materials, machine tools, etc., from Cleveland to the East to be used in manufacturing there. The works belonging to the company, located on Mason and Belden streets, Cleveland, are now partially occupied by tenants engaged in metal working and other manufacturing, but some extensive and well equipped shops are still to be let.

The Electrical Engineering company of Minneapolis has secured the services of R. A. Powell as one of its traveling salesmen. Mr. Powell was formerly with the Minneapolis Electric and Construction company and enjoys an extensive acquaintance in that locality. He will cover Minnesota and Northern Wisconsin, and in addition to the general line he will push the sale of the Buckeye lamp and the various styles of telephones put out by the company.

The H. W. Johns Manufacturing company, New York, some time ago concluded arrangements with Bergtheil & Young, 12 Camomile street, London, E. C., for the sale abroad of its well-known "H. W. J." electric car heaters, moulded mica trolley line, vulcabeston and other insulating materials. E. B. Hatch of the Johns-Pratt company, Hartford, Conn., who represented the Johns company in a recent trip to England and France, reports that the Johns name is already recognized on the other side, and that, through the efforts of Messrs. Bergtheil & Young, a great number of orders for foreign account are to be expected during the year. Several roads in Europe have during the last three years been insulated throughout with the trolley materials manufactured here by the H. W. Johns Manufacturing company.

The Garvin Machine company of New York has issued a book of well executed views of its new building and plant. The business was established in 1862, and incorporated in 1889 as the Garvin Machine company. The disastrous fire of March 6, 1896, made it necessary to seek the new quarters, which are equipped throughout with electrical power for driving machinery, one passenger and two freight elevators and also for lighting. Every modern convenience has been installed, including a telephone system of 26 stations, and call bells connecting all departments. The equipment throughout, of both large and small tools, being entirely modern, the facilities for construction are unexcelled.

When the duty on carbons was placed at such a high figure, it was generally thought among the electrical trade that this would result in the practical extermination of the import business of this class. However, in a recent interview, Hugo Reisinger of 38 Beaver street, New York, declares that instead of there having been a falling off in his business, there has been a decided increase, of which he feels very proud, because it is his belief that it demonstrates beyond question the superiority of the Electra carbon for direct and alternating current arc lamps.

BUSINESS.

The second of the Western Electric company's advertising pictures is a reproduction of a famous battle scene of antiquity. The half-tone and printing are good, and the picture is worth preserving.

The Stromberg-Carlson Telephone Manufacturing company, Chicago, reports a steady increase in demand for interior systems, especially from eastern cities. Among the recent shipments are several orders to the Pennsylvania Railway company at Pittsburg, Pa., for the various offices, and a large equipment for the Scott Block, Erie, Pa.

Light weight, with high efficiency, durability and compactness, is claimed for the Hatch accumulator, made by the Hatch Storage Battery company of 53 State street, Boston. Cansten Browne, the eminent lawyer, gives it as his opinion that the Hatch batteries do not infringe the Brush patent. A descriptive pamphlet is sent on application.

The Upton "Midget" enclosed arc lamps are made by the Standard Thermometer and Electric company of Peabody, Mass., for constant potential, constant current and alternating circuits. The length of the lamp is only 22 inches, and the carbons burn from 80 to 150 hours (according to the type) without retrimming. This company also makes open arc lamps.

Perhaps the most compact push-button switch on the market is the F. & L. push flush switch, for which the Electric Appliance company of Chicago is general selling agent. The face-plate of this switch is no larger than an ordinary one-light gas key, and the switch operates on very much the same plan. It is easy to operate and sure in its results, and it is low in price.

On September 7th and 21st and October 5th and 19th the Chicago, Milwaukee and St. Paul Railway company will sell round-trip excursion tickets to a great many points in the western, southwestern and northwestern states, both on its own line and elsewhere, at greatly reduced rates. Details as to rates, routes, etc., may be obtained on application to the ticket agent at 95 Adams street, Chicago.

Power pumps for every service and their applications are considered in the new catalogue of the Goulds Manufacturing company of Seneca Falls, N. Y. Many types of pumps are shown, including electrically driven pumps, both direct-connected and belt-connected. Especial stress is laid on the triplex power pump, which, it is said, represents the best design and construction. The Chicago office is at 22 North Canal street.

The Detroit Lubricator company, Hodges building, Detroit, Mich., has just issued a new catalogue showing the different lubricating devices manufactured for the different kinds of engines. Besides showing a very complete line of sight-feed lubricators, glass and brass oilers, oiling devices, globe valves, etc., the catalogue contains some tables and data, such, for instance, as shown on page 7, which are of general interest to all users of steam power. A copy will be sent to anyone applying for it.

The long expected wave of prosperity has at last reached Chicago, and its effects have been felt by the Hartley Electrical Works, 263 Randolph street, Chicago, of which B. Hartley is manager. The Hartley company makes a specialty of electrical repairing in all its branches, and Mr. Hartley is particularly well fitted for this work, having had an experience of over 12 years. The company also deals in new and second-hand dynamos, motors and transformers and other electrical goods. At the present time it has on hand a dozen or so solid brass eight-light electroliers and a number of other articles which it is willing to sell at a sacrifice.

M. I. Vought, La Crosse, Wis., manufacturer of electrical specialties, who has recently placed on the market the "two balls" adjustable hanger for incandescent lamps, reports a very flattering business. He says that his sales are running beyond his expectations and that his factory is compelled to work overtime in order to keep up with the demand. The incandescent lamp adjuster mentioned is being sent out by him in dozen and half-dozen lots to be returned if not entirely satisfactory, and Mr. Vought declares that not one as yet has been returned. The lamp adjusters are gotten out in black, white and gilt finishes, also brass and nickel, the last with a ceiling canopy to match, making a very handsome fixture for the home library. Many of the black finish are used in shops, offices, breweries, mills and factories.

The Central Electric company of Chicago is issuing a neat and comprehensive small catalogue of electric railway quick-break, snap fusible switches. These switches are made in various designs for con-

trolling car-light circuits, also in combinations, so that one switch will control two headlights as well as the car light circuit. The company is distributing these catalogues to its patrons, and is pleased to furnish them upon request. It is also sending out with these catalogues circulars of its changeable electric headlights. The Central Electric company has equipped a great many roads with these headlights, and in every instance, it is asserted, satisfaction has been the result.

The new catalogue of the Clayton Air Compressor Works of New York is a good one. It shows the many uses to which compressed air is applied and enumerates all sorts of compressed-air tools and appliances. But the novel feature is in the back of the book, where 27 pages are devoted to the advertisements of other businesses, from patent attorneys to bridge builders. Every page has the headline "Clayton Air Compressor Works," and the catalogue has an "Index to Advertisements" and the request, "Please mention this book in communicating with our advertising patrons." Whether the pamphlet is properly a catalogue, a house organ or a new effort at co-operation is hard to determine. At any rate, it is a good thing for the Clayton Air Compressor Works.

One of the most useful catalogues for the telephone trade is gotten out by the Farr Telephone and Construction Supply company, 342 Dearborn street, Chicago. This little book, which contains almost 100 pages, not only includes descriptions of all sorts of telephones, batteries, switchboards, construction supplies and electric specialties, but also devotes considerable space to the putting up of telephones, locating faults and general instructions for telephonists, and in addition gives a number of diagrams of special value to those installing telephones. The Farr company has done a large business in its particular line, and the indications for a large fall trade are very bright. Anyone contemplating the purchase or installation of telephones will do well to secure a catalogue from the Farr company.

ILLUSTRATED ELECTRICAL PATENT RECORD.

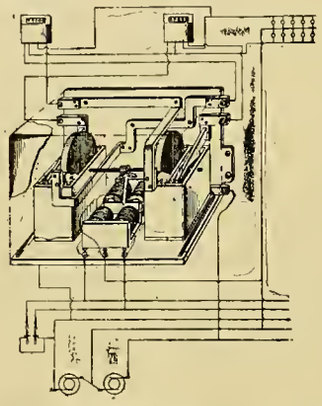
Issued August 17, 1897.

588,144. Electric Trolley Device. Samuel Harris, Johnstown, Pa. Application filed December 3, 1896.

A slidable carriage for electric trolley devices is composed of a contact-maker, plates between which the contact-maker is mounted, tubular connections between the plates, and suitable hearings within the connections.

588,145. Electric Trolley Device and Conductor Construction Therefor. Samuel Harris, Johnstown, Pa. Application filed January 20, 1897.

A conductor connection is adapted for use at bridges, with trolley devices employing large wheels adapted to make contact with a suspended conductor, having a horizontal portion adapted to be placed under the bridge, and inclined portions at each end thereof connected to the conductor and adapted to turn the contact wheel to a nearly horizontal position.



NO. 588,170.

588,170. Method of and Apparatus for Multiple Rate-metering for Electric Currents. Eustace Oxley, Washington, D C. Application filed June 19, 1897.

The method is described of separately metering the consumption of currents during different periods, which consists in connecting with each of a series of consumers' circuits a plurality or series of metering mechanisms electrically controlling from a single point the operative selection of one series, and simultaneously effecting from the point the connection of all the meters of that series and the disconnection of the other series.

588,188. Electric Contact Device. David S. Shallenberger, Johnstown, Pa. Application filed January 30, 1897.

Features of construction include a longitudinal I-beam, a contact-carrying arm carrying rollers at its lower end adapted to engage the sides of the I-beam, a member pivotally secured at its outer end to the arm, and means for imparting upward pressure to the outer end of the member.

588,189. Accumulator Battery. John V. Sherrin and Henrietta H. Sherrin, London, England. Application filed March 22, 1897.

There is the combination of a core, conductors helically wound thereon, a strip of springy non-conducting material helically wound on the conductors in the opposite direction, and interstitial active material.

588,206. Protective Appliance for Electrical Apparatus. Arthur S. Williams, Newton, Mass. Application filed May 7, 1897.

This device is adapted to be held in supports under spring pressure, and normally forming an electric connection between the supports, but adapted to dissever the same, consisting of a metal thimble provided with a heating coil at one end, an insulated pin extending from the opposite end through the coil, and a metal tube concentric with the pin and soldered to the hobbin of the coil.

588,251. Recording Instrument. William Thomson, Largs, Scotland. Application filed October 2, 1896. Patented in England December 28, 1895.

One claim is for the combination of the marking point, the paper and platen having means in connection therewith for oscillating it to and from the marking point, and suitable means for feeding the paper forward as the platen is oscillated.

588,258. Switchboard Apparatus. Walter F. Banks, Milford, Conn. Application filed October 1, 1896.

Provision is made so that a call may be received at the central station over the telephone and calling line, and by manipulating the plug or switch the telephone line may be thereupon connected to the calling line, so as to cut the battery out of the telephone talking circuit.

588,267. Electric Furnace. Guillaume de Chalmot, Leaksville, N. C. Application filed December 24, 1895.

An overflow opening is combined with a revolving part arranged beneath it to receive the overflowing material, and means are provided for sprinkling a layer of subdivided material upon the revolving part in advance of the falling upon it of the material overflowing from the furnace.

588,276. Electrolytic Process and Apparatus Therefor. Carl Kellner, Vienna, Austria-Hungary. Application filed February 24, 1896. Patented in Belgium April 11, 1895; in France April 11, 1895; in England April 11, 1895; in Norway July 16, 1895, and in Italy September 30, 1895.

Several decomposing cells having mercury cathodes and suitable anodes are connected in series, together with a plurality of oxidizing cells connected in series.

588,306. Automatic Rheostat Controller. Robert Wilson, Louisville, Ky. Application filed May 29, 1897.

An actuating lever, a cam moved thereby, a rheostat lever controlled by the cam, and means whereby the actuating lever is permitted to move a short distance independently of the cam, are described.

588,320. Lightning Arrester. Cummings C. Chesney, Pittsfield, Mass. Application filed May 14, 1897.

There is a nest of concentric cylinders having flaring sides, the parts being separated from each other; a line terminal and a ground terminal are also used, the latter being connected to the outer cylinder.

588,348. Holder for Incandescent Lamps. Charles H. Otis, Orange, Conn. Application filed March 10, 1897.

A clasp is adapted to embrace the neck of the lamp, and to be detachably secured upon it, the bracket arms pivoted to the clasp at one of their ends, and a wire-receiving socket at the other end of the arms, by which wires or cords may be attached.

588,382. Electrical Conductor. James D. Bishop, New York, N. Y. Application filed May 6, 1897.

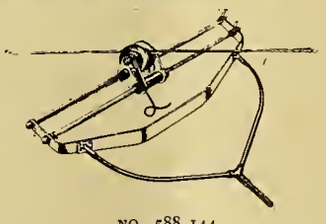
Wire ribbons are wound side by side, having intervening air spaces.

588,391. Electric Motor Car Truck. George M. Brill and John A. Brill, Philadelphia, Pa. Application filed March 25, 1890.

An electric motor frame is journaled at one end upon a car axle, with a cross-bar elastically connected at each end with the truck frame, and a mechanical connection between the other end of the motor frame and the middle of the cross-bar.

588,396. Electric Railway System. Jean Claret and Olivier Vuilleumier, Paris, France. Application filed August 4, 1896. Patented in France June 8, 1895, and in Switzerland December 2, 1895.

An essential feature is a distributer having a series of keys to be connected to the spaced contacts of the railway, contact arms to move over and touch the keys, an electric motor to move the arms, a locking wheel secured on the shaft of the moving part of the motor with elastic connections, armature levers to lock the wheel and electro-magnets to act on the armature levers.



NO. 588,144.

588,399. Electric Fire Engine. George W. Cox, Stuart, Ia. Application filed December 30, 1895.

An electric motor and a rotary pump are mounted on the same shaft; a suitable water-tank is supported between the wheels of the carriage; a storage battery is mounted on the tank, while wires connect the storage battery and motor and the pipes leading from the tank to the pump.

588,435. Rail Bond for Electric Railroads. Victor E. Hunter, Cleburne, Tex. Application filed June 24, 1897.

A split-headed axially and angularly bored coupling bolt, a connecting wire extending through the perforation and bent or coiled once around the bolt, and means for clamping or compressing the bend or coil of the wire firmly against the side of the rail.

588,448. Trolley. Frank Krabal, Pittsburg, Pa. Application filed August 22, 1896.

The combination with the trolley pole, having the trolley wheel journaled therein, of standards or guides on the trolley pole, spring-operated levers on the trolley pole, and pivoted spring arms or guards on the levers within the standards or guides extending across the trolley wheel and movable laterally and toward each other.

588,465. Trolley Bicycle. Robert T. Oney, Charleston, W. Va. Application filed September 10, 1895.

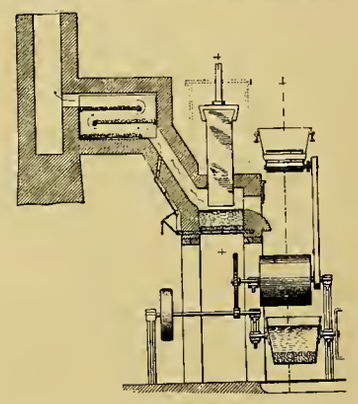
A trolley driven carriage is arranged to run upon ordinary roads, and having an electric motor geared to one of its wheels, in combination with a trolley pole connected to its main frame and carrying a double-wheeled trolley; two conductor wires are arranged on opposite sides of the trolley and hold it between them, while branch wires lead from the two trolley wheels to the two poles of the motor.

588,489. Magnetic Switch Lock. Sidney H. Short, Cleveland, Ohio. Application filed December 22, 1896.

A mechanical latch is adapted to lock the switch in at least two positions, and an electro-magnet is connected in the main circuit, exerting its magnetic force to prevent the unlatching movement of the latch.

588,490. Brush-holder Support for Electric Generators or Motors. Sidney H. Short, Cleveland, Ohio. Application filed January 2, 1897.

An adjustable rocker is mounted concentrically with the commutator and radially adjustable brush-holder hangers.



NO. 588,267.

588,491. Multipolar Dynamo, Motor or Rotary Transformer. Sidney H. Short, Cleveland, Ohio. Application filed March 12, 1897.

A yoke having magnetic cores extending therefrom close to an armature, whereby a magnetic circuit of low reluctance is provided, in combination with closed-circuit metallic bands or conductors of low electric resistance surrounding the yoke between the magnet cores.

588,511. Transmitter. Anthony Van Wagenen, Sioux City, Iowa. Application filed April 30, 1896.

Circuit making and breaking mechanism is movable in a prescribed path forward and having no return or backward movement, and locking mechanism normally engaging the circuit making and breaking mechanism and preventing movement thereof, but adapted to be thrown out of engagement therewith by the operation of the power-storing mechanism.

588,524. Electrolytic Apparatus. Edward Balbach, Jr., Newark, N. J. Application filed July 2, 1896.

The cathode case is composed of a trough having its bottom divided into two portions, one of which is horizontal and the other inclined, so as to slope down to and connect with the horizontal portion throughout its length, and provided with a cathode plate, and an anode suspended therein arranged to cover the horizontal portion of the bottom only.

588,528. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa. Original application filed July 19, 1886. Divided and this application filed July 20, 1895.

The method described of operating an electric railway consists in maintaining a current of constant potential in line circuits extending along the railway, supplying current therefrom to an electric motor and secondary batteries on the car, changing the counter-electromotive force of the secondary batteries to a higher potential approximately equal to that of the line circuit, and regulating the speed of the motor by controlling the current delivered to the motor while maintaining the higher potential of the batteries.

588,541. Current-conducting Rail for Electric Railways. Louis E. Walkins, Springfield, Mass. Application filed May 21, 1897.

This rail is composed of a body of iron or steel, and has its tread side covered with a layer of copper welded thereto.

REISSUED.

11,626. Electric Burglar-alarm. Clyde Coleman, Chicago, Ill. Application filed January 18, 1897. Original No. 570,906, dated November 10, 1896.

The combination is claimed, with a structure or district inclosed and surrounded by electrical conductors, of an electric protective circuit or circuits including the conductors, an alarm device controlled thereby and at a distance from the protected structure, and time mechanism inclosed within the electrical barrier at the protected district for throwing off the alarm to permit access to the guarded structure.

Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, SEPTEMBER 4, 1897. No. 10

An Incident of the Grand Army Meeting.

By Orrin E. Dunlap.

Several hundred thousand people attended the national encampment of the Grand Army of the Republic, held in Buffalo the last week in August, and the majority of them visited Niagara Falls. This resulted in all the avenues of travel to that popular resort being crowded to the utmost capacity, and all the steam and electric roads did a very big business. This was especially true of the Buffalo and Niagara Falls electric road, the cars of which were loaded as they were never before in their history. Thousands upon thousands of people enjoyed the ride from the Queen City to the Power City in the yellow cars, and all were cared for without accident. It was on the return to Buffalo that the crowds fought to get seats, or even standing room on the cars, and the scene at the foot of Falls street in Niagara Falls was one never to be forgotten. The picture presented shows one of the Ely line cars besieged by an anxious crowd at the foot of Falls street, hundreds of others standing about realizing how useless it would be to try and get a seat thereon. Men and women climbed into the windows of the cars while the passengers down were getting off, the motto seeming to be "Any way to get in." The cars were stopped four and five blocks up the street by people anxious to return to Buffalo, but in the majority of cases the down cars were so crowded that more could not get on.

The Gorge road also enjoyed a heavy patronage, and cars were borrowed from the Niagara Falls and Suspension Bridge line to afford sufficient facilities for transporting all the people. No accident occurred to mar the enjoyment of the many who sought pleasure at the Falls, and for this the managers of the roads are thankful and happy.

AN INCIDENT OF THE GRAND ARMY MEETING.

Union Loop Completed.

The Union elevated railway loop is practically completed, and it is expected that the trains of the Lake Street and Metropolitan companies will make the complete circuit of it within a couple of weeks. The electric power plant of the Union Elevated Railroad company, on Market street, at the foot of Congress street, is far from completion, and it is likely that the current for the operation of the trains will continue to be taken from the Hawthorne avenue station of the North Chicago Street Railroad company for some time. The contract for track privileges on the loop has not been signed by the Alley "L" people, it is said, and it will probably be several months before the cars of this company are operated over the loop.

The Chicago Tribune claims to have information about the rental arrangements proposed by the Union Elevated Railroad company and accepted by three of the four outlying elevated railroad companies. It says: "There is to be a total rental and a guarantee minimum rental. The first includes the payment of half a cent for each paying passenger each line carries and proportionate payments which each road contributes toward the operating expenses of the loop. The minimum rental will include the expenses of maintenance and operation of the loop and power house, with ground rent; secondly, the net sum of $250,000 per annum, and, thirdly, the cost of maintaining the corporate existence of the loop company. The total rental paid by whatever number of roads use the loop must always be equal to this minimum. If one of the companies (applies to the Northwestern) signing the agreement is not ready to use the loop it will pay only $62,500 per annum as rental. Until the loop power house is built the lessee roads will furnish their own power. Under the agreement if only the Lake Street, Metropolitan and Northwestern execute the lease at present, the Northwestern Elevated will pay $62,500 a year, while the Metropolitan and Lake Street Elevated will divide the loop expenses between them according to traffic, and will pay in addition one-half cent a passenger, which one-half cent for both roads must amount to $187,500 a year. At present, roughly, the Metropolitan has about four-sevenths of the total traffic of the two roads and the Lake Street about three-sevenths. The Metropolitan's minimum, therefore, would have to amount above expenses to about $107,500 a year, and the Lake Street to about $80,000 a year. At one-half cent a passenger this would take an average traffic of about 44,000 daily for the Lake Street and 59,000 daily for the Metropolitan. At times the traffic of both roads has reached these figures.

"The disagreement between President Carter [of the South Side company] and the Union Loop people is understood to have some reference to the guarantee minimum rental, which the fromer claims to be excessive. There appears to be no immediate prospect of the Alley 'L' entering into the agreement, as the hitch still is on a vital point. But the other companies, it seems, are now satisfied, and will no longer wait for the Alley 'L' to sign."

Westinghouse Company Reported to Have Absorbed the Gibbs Company.

It is reported that the Westinghouse Electric and Manufacturing company has secured the control of the factory, good-will and business of the Gibbs Electric company of Milwaukee. The statement has not been officially confirmed, but it is widely circulated without denial. The Gibbs company has made a good reputation for itself in the manufacture of motors and special motor devices, and is believed to have done a good business.

Mr. Scribner's Effective Burglar Alarm.

Charles E. Scribner, the leading expert of the Western Electric company, resides at 172 Forty-fifth street, Chicago, and the practical efficacy of his electrical knowledge was recently demonstrated by the capture of a burglar. A morning newspaper tells the story: Eric Petersen and Albert Nelson heard a burglar alarm ringing in the house of Charles E. Scribner of 172 Forty-fifth street. They started to enter the residence when they saw a man dash out of the rear door and start for the street. The two followed, and after a chase the man was captured. He gave the name of Frank Woods. Neighbors had telephoned the police of the Hyde Park station that the burglar alarm was ringing in the Scribner residence, and the patrol wagon arrived just after the capture. A kit of burglars' tools and a bunch of skeleton keys were found inside the rear hallway. The police claim that Woods is much wanted on other charges of burglary. The Scribner family was out of town.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the Western Electrician.]

The Eau Claire, Wis., Telephone company has been incorporated with $100,000 capital to operate the local exchange, and the Wisconsin Valley Telephone company, with $200,000 capital, has been incorporated to maintain long-distance lines. They are both Keelyn companies and promise big things, including the construction of 5,000 miles of line.

The Interstate Telephone and Electric company has been organized at Dubuque, Ia., with $100,000 capital. R. W Stewart, the promoter, claims to have money in sight to put in a telephone system. F. F. Sapp of Chicago is named as president of the company.

The Spokane and British Columbia Telephone and Telegraph company proposes to have connections between Spokane and Kaslo within 60 days.

The North Montana Telephone company of Great Falls will enlarge its plant and make extensions to Fort Benton, Browning, Kalispel, Libby, Troy and Sylvanita.

J. H. Jansen, formerly manager of the Wisconsin telephone exchange at Ashland, Wis., proposes to organize a company to put in a new system there.

An extension to East Chain Lakes is proposed by the Fairmont, Minn., Telephone company.

The Western Minnesota Telephone company has bought the local system at Olivia, Minn

L. S. Taintor of Menomonie, Wis., has been elected president of the Wisconsin Telephone company, and Mr. Heafield of the same place secretary.

Telephone connection between Eau Claire, Wis., and Milwaukee has been made.

The Dakota Central Telephone company has completed connections, giving it 37 stations.

The committee of the St. Paul Assembly decided that the proposed ordinance giving a franchise to the American Telegraph and Telephone company was too indefinite, and it was referred for further overhauling.

The $750,000 mortgage (original copy) given by the Iowa Union Telephone company to the Illinois Trust company is reported to have been lost in the mail.

Work is being rushed on the Dubuque telephone line, and the company expects soon to have connections with the Twin Cities.

Telephone connection was formally opened between Minneapolis and New York, Boston, Chicago, Philadelphia, Detroit, St. Louis, Louisville and other towns on August 31st. The introduction of the long-distance telephone to the business men of the city took the form of an "opening." The long-distance franchise is controlled by the American Telephone and Telegraph company, and it united with the local exchange in sending out 1,200 invitations to business men and to others throughout the state During the afternoon there were probably some 300 or 400 responses in the form of calls.

Wonders Never Cease.

[From the Richmond, Va., correspondent of the Western Electrician.]

A curious thing is reported from Staunton. The telephone people, whose experience with pretty telephone girls has not been altogether satisfactory, advertised for ugly girls, and there were 25 applicants!

W. C. Wright of Aberdeen, S. D., contemplates the establishment of an electric light plant in Watertown, S. D.

Armature Reactions in a Rotary Converter.[1]

By Prof. R. B. Owens, D. W. Hawksworth and H. W. Doubrava.

It was primarily desired to obtain curves showing the instantaneous distribution of induction over the pole faces of a rotary converter for different armature positions and conditions of loading.

In general the method employed to effect this consisted in measuring the instantaneous electromotive forces under different conditions, generated in a series of small equally even spaced coils of fine wire wound over the armature surface, the electromotive forces in these coils in any position being, of course, proportional to the induction density in that part of pole opposite coil.

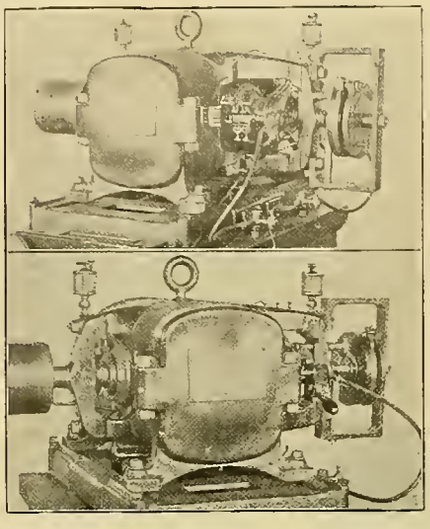


Fig. 1.

The machine experimented upon is of the well known consequent pole type, made by the old United States company. Its output is 3½ kilowatts at 110 volts; normal speed, 2,400 revolutions per minute.

Fig. 1 shows two views of machine. At the commutator end are seen three slip rings, connected to commutator, also the contact-maker at the end of shaft. At the pulley end are two contact rings to which the several test coils may in turn be connected. The armature is drum wound with smooth core. The commutator has 54 segments.

The machine, originally designed for a continuous current generator, was changed as shown into a three-phase converter by placing slip rings on the armature shaft and connecting segments 1, 19 and 37 of the commutator respectively to rings 1, 2 and 3. No suitable three-phase generator being available, it was used only to convert continuous into three-phase currents. The applied voltage at the brushes was kept exactly at 110 volts, the energy being supplied by a 15 kilowatt Edison generator.

Instantaneous electromotive forces were measured by the usual zero method, using telephone.

The particular contact maker used may, however, be described. An iron ring was cast in the form indicated in Fig. 2, and attached to a hard rubber disk about one-half inch thick. A A¹ are glass wedges and B is a thin steel clock spring placed between them; C is a screw with insulated head by which the wedges are forced into a wedge-shaped slot in the rim and held firmly in place. The metallic strip B is connected to the contact ring E. The glass wedges and strip are ground even with the rim of the cast-iron ring. The contact brush, which consists of two thin steel watch springs, coming in contact only with polished metal and glass surfaces, wears well, and the contact is always clean and good. No difficulty whatever was experienced in reading electromotive forces to less than one-fiftieth of a volt.

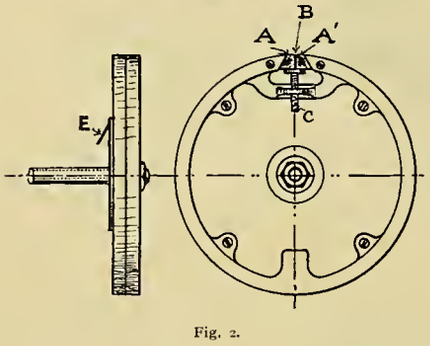
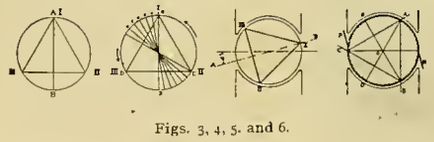


Fig. 2.



Figs. 3, 4, 5. and 6.

Since the object desired was to show the instantaneous induction distribution over the pole faces, and the variation in induction density in particular points on the polar surface as the armature and armature currents varied in position and value, the ordinary single or two-brush method of exploring commutator potentials for continuous current machines would evidently be useless. First a single coil of fine wire was wound lengthwise around the armature and the ends connected to the contact rings at pulley end of machine. Fig. 3 represents the relative position of coil and three limbs of secondary circuit of converter; A B is the fine wire coil wound through the point where one contact ring is tapped; I-II, II-III and III-I represent the three limbs of the secondary circuit.

The machine was first run as a motor with no load and the curve in plate 1 obtained. This shows the induction distribution to be quite uniform over polar surface, but slightly shifted in opposite direction to rotation. This would naturally be expected as the armature reactions with so small an armature current would be but slight.

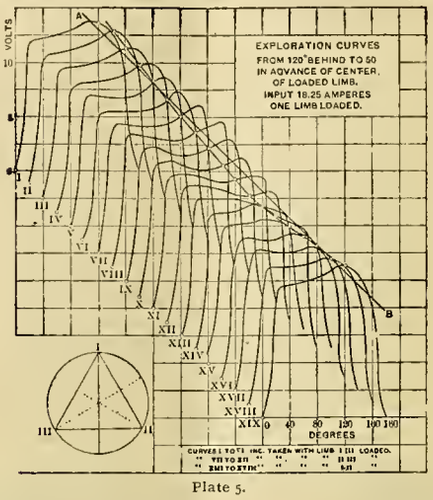


Plate 5.

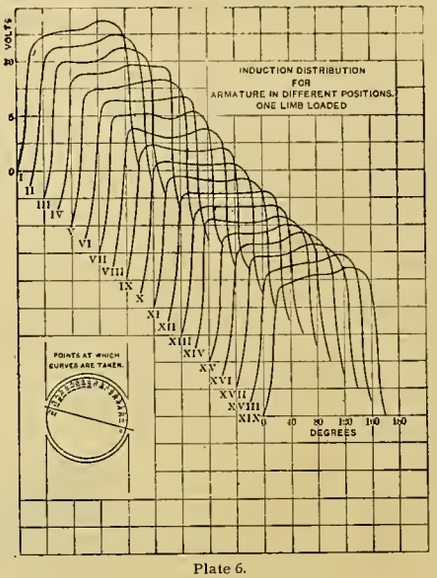


Plate 6.

The machine was again run under steady load as a motor up to about its full capacity, the armature taking 32.6 amperes. In this case the distribution curve shows a very decided distortion of the field, as indicated by curve, plate 2. Both of these curves are exactly like what would have been obtained by the ordinary two-brush method of exploring commutator.

The machine was next run as a converter, the three limbs being equally loaded with incandescent lamps. The armature took 39.45 amperes. Although in this case the armature current is much larger than when the machine was operated as a motor, no shifting of the brushes was necessary to avoid sparking, as was before the case, showing the small reactions in a rotary converter. The curve in plate 3 is the exploration curve from the same test coil for this case, and curve in plate 4 is the exploration

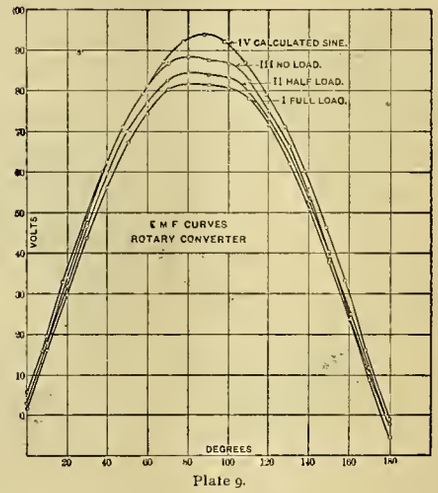


Plate 9.

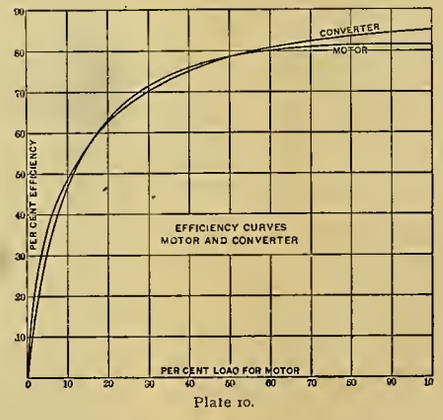


Plate 10.

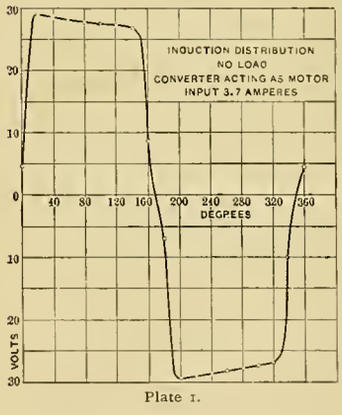


Plate 1.

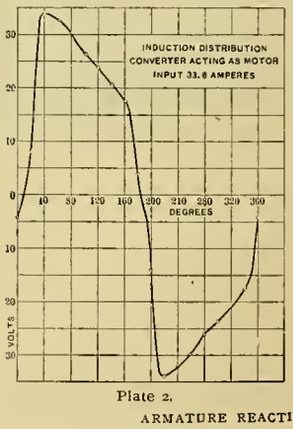


Plate 2.

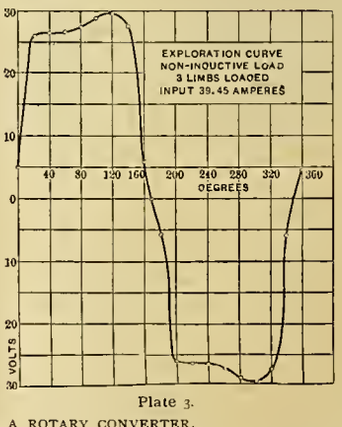


Plate 3.

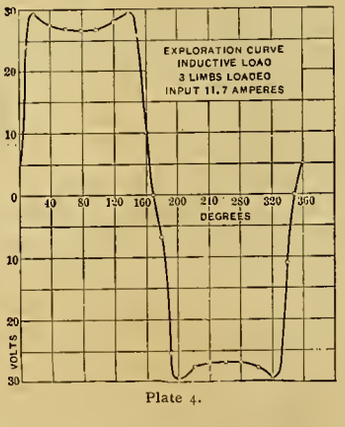


Plate 4.

ARMATURE REACTIONS IN A ROTARY CONVERTER.

1. Read at the fourteenth general meeting of the American Institute of Electrical Engineers, Eliot, Me., July 26-28, 1897.

curve from test coil when equal inductive loads were put on the three limbs, the armature taking 11.7 amperes. The last two curves must not be confused with curves which show the instantaneous distribution of induction for particular armature positions and loads. They merely show the induction at a fixed angular position from the loaded legs as the armature assumes different angular positions. From a series of such exploration curves the instantaneous induction distribution can, however, be easily obtained as follows: First, we will consider the case of a single limb loaded. It will be seen by an inspection of Fig. 4 that placing test coils 10 degrees apart at points 1, 2, 3, 4, 5 and 6 and taking readings from each separate coil with limbs I-II, II-III and III-I loaded separately, is the same as having but one limb loaded, and coils placed 10 degrees apart entirely around the armature. The three armature windings being known to be practically identical when the limb I-III is loaded, test coil 1 will give the induction 60 degrees behind the center of loaded limb; coil 2, 50 degrees; coil 3, 40 degrees, and so on to coil 6. When limb II-III is loaded, the curve from coil 1 shows the variation of induction at the center of the loaded limb, coil 2 shows the variation of induction 10 degrees in advance of the center, and so on up to coil 6.

When limb I-III is loaded, test coil 1 gives the variation of induction 120 degrees behind the center of the loaded limb; test coil 2, 110 degrees behind, and so on up to coil 6. Thus are obtained a series of 18 curves, showing the instantaneous induction for every 10 degrees from 120 degrees behind the center of the loaded limb to 50 degrees in advance of the center as the armature rotates. The 18 curves numbered I. to XVIII. are shown on plate 5. The origin of each curve is shifted 20 degrees to the right and 1¼ volts below that of the preceding curve for clearness.

From those exploration curves the instantaneous induction distribution for particular positions of the armature is easily found. Suppose that the center of the loaded limb is on the line of commutation, which in all cases is 15 degrees from the point midway between the pole tips, as shown by line A B in Fig. 5, and that the distribution was desired for the limb in this position. The line of commutation is taken as reference line. It will be seen by reference to Fig. 4 that taking the zero point of curve VII. gives the induction at the point where the center of the loaded limb is at zero degrees; then if the reading is taken at 10 degrees on curve VIII., the amount of induction for 10 degrees in advance of the center of the limb, which is still in same position, is obtained. The induction for 10 degrees further will be represented by the reading for 20 degrees on curve IX., and so on.

The series of readings for curves in plate 6 were obtained in this manner, and show the instantaneous distribution of induction over the pole faces with one limb loaded in different angular positions.

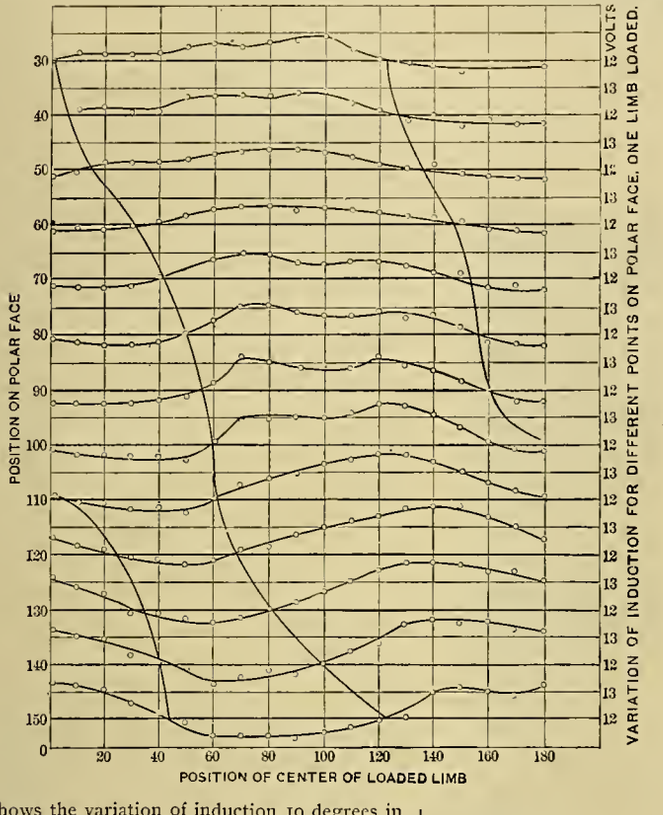
Of course, the same curves might have been obtained directly, by measuring successively the electromotive force in each of a series of test coils evenly spaced for one particular position of the loaded limb or armature, but the above indirect method is easier of manipulation.

The curves in plate 7 show the variation of induction through particular points in the polar face as the loaded limb assumes different positions. These curves are obtained directly from the curves in plate 5. Suppose it is desired to draw a curve representing the variation of induction at 140 degrees from the zero point. Connect the points where a vertical through the 100 degree point of each curve intersects the curve. The new curve so found, when compared with the right line A B, drawn through points representing 140 degrees and 12 volts for each curve, shows the variation above or below the induction corresponding to 12 volts.

Taking points from 30 degrees to 150 degrees, inclusive, and changing the axes, gives the series of curves, plate 7. It will be noted that the variation of induction at some points is greater than at others, and that the waves of variation differ in phase, as of course would be expected. Connecting the points where these curves cross the 12 volt line shows the variation of induction at successive points in time and amount very nicely.

The exploration curves in plate 8 were taken with all three limbs equally loaded with incandescent lamps. When one limb is loaded, any particular distribution of induction occurs twice in every revolution of the armature, but with three limbs loaded this happens six times per revolution. In plate 8 curve VI. is exactly similar to curve I., and, referring to Fig. 6, it will be seen that the distribution of currents in the armature will be the same when A B and C are either at N or P. The curves showing instantaneous distribution of induction with armature position can be obtained from the exploration curves in plate 8 in the same way that curves in plate 6 were obtained from curves in plate 5.

The shape of the electromotive force curves taken from a rotary converter depends on the induction distribution. If the lines of force through the poles, air gap and armature were uniform and parellel, the electromotive force in each turn of wire on the armature would be sinusoidal, and the electromotive force as measured between any leg, being the sum of sine waves, would also be sinusoidal, but the electromotive force curve we actually get is the sum of a series of electromotive force curves similar to curves in plate 5, differing in phase by the conductor angle. On plate 9 are shown electromotive force curves between legs for different loads. Curve I. is for full load, curve II. for half load and curve III. for no load. Curve IV. is a sine wave whose R. M. S. value is 67.4 volts. Plate 10 shows the efficiency curves for the machine as a motor and as a converter. If the load on the machine as a converter had been increased until the losses equaled the losses of the motor at full load, then the ratio of the two outputs would be the relative capacities of the same machine working in the two ways.



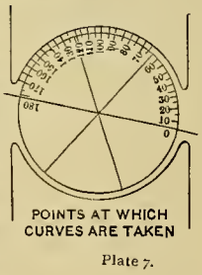
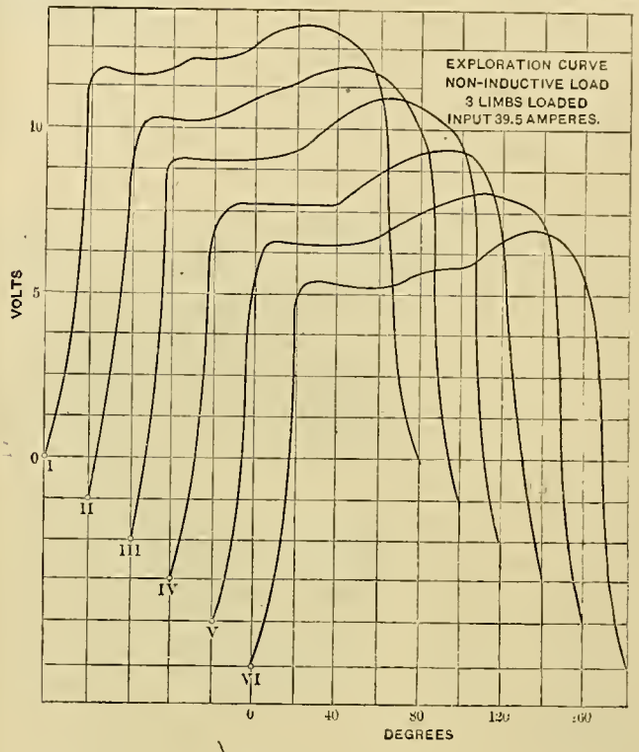


Plate 7.



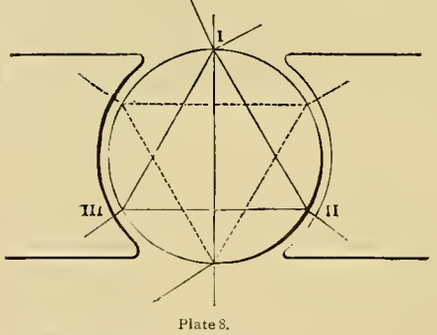


Plate 8.

ARMATURE REACTIONS IN A ROTARY CONVERTER.

Western Union Claims Against the Government.

First Assistant Postmaster-general Heath expects to make his report, as referee in the claim of the Western Union Telegraph company against the Postoffice Department, within a week or 10 days, says a Washington correspondent writing under date of August 28th. He has had a force of clerks working on the report for the last two months, and hopes to have it in shape in a few days. The case involves an amount estimated to be from $600,000 to $1,000,000. It grew out of the reduction by Mr. Wanamaker, when he was postmaster-general, of the rate of toll paid the telegraph companies.

Mr. Wanamaker was an enthusiastic advocate of the postal telegraph scheme, and he also wished to reduce to a minimum the amount paid by the government for its telegraph service. Under the law of 1866 the postmaster-general had at that time the right to fix the amount paid for telegraphic service by all the departments of the government. Mr. Wanamaker reduced the rate greatly from that fixed by his predecessor, Mr. Dickinson, and wished to reduce it to about one mill a word. The service had been worth $200,000 to the Western Union up to this time. The company entered a strong protest against the reduction, and for about three years refused to send in a bill. It did, however, transmit the messages, but received them under protest.

When Mr. Bissell became postmaster-general, he restored the rate fixed by Mr. Dickinson, and the company began rendering its bills once more. It then brought suit against the government in the United States Court of Claims for the money due on the telegrams sent during the last three years of the Wanamaker administration, and the court appointed two referees to audit the account. One was C. O. Shepherd, at that time chief of the Salaries and Allowance Division of the department, who was chosen to act for the department. The other was William A. Brown, selected by the attorney for the Western Union. These two referees began the work in rooms in G street. The telegrams amounted to more than a million in number and were brought over from the Western Union office in boxes. The auditing of these required considerable time, and the work dragged along for several years. At length, the Western Union became tired of the dilatory proceedings. No appropriation having been available for the work, the company had to advance the money, and after it had expended about $8,000 it asked the court to set a time limit for the report. The court ordered the referees to report

last November, but they did not do so. They set up the claim that they had not been paid by the Western Union for their work.

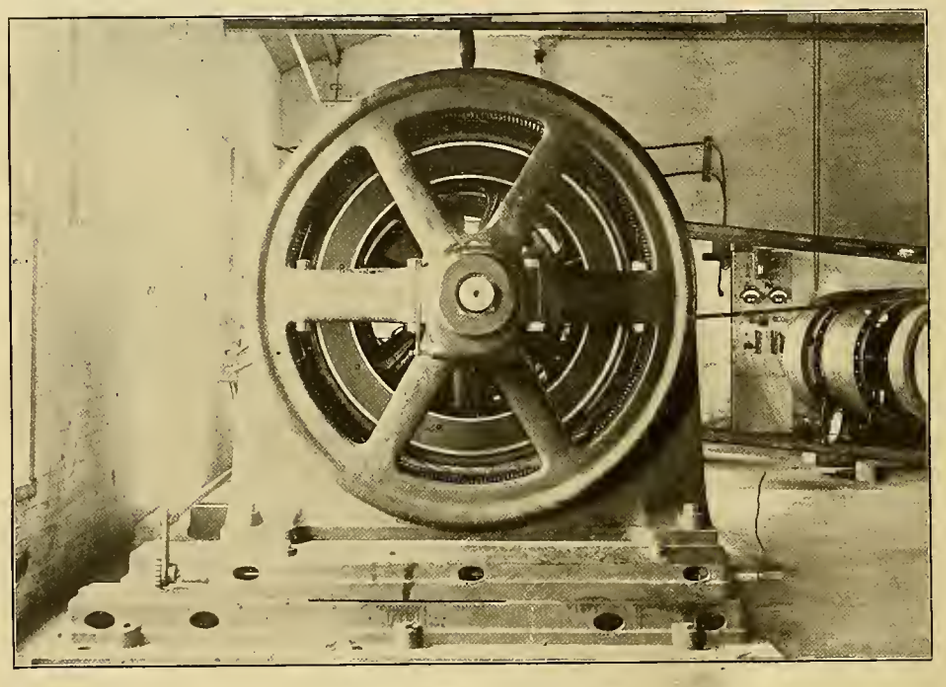
When the present administration came into power and Mr. Shepherd resigned, the department wished to substitute Mr. Heath. The Western Union agreed to accept him as sole referee, and his appointment was made. Mr. Brown rendered his report, but up to the present time Mr. Shepherd has made no report. In order to be certain of the correctness of the accounts, Mr. Heath had them all re-examined, and the work is now about completed. When the report is made it will go to the court and arguments will be heard in the case.

It is a grave question whether the government has the right to force upon a company for its services pay which the company deems grossly inadequate and would refuse from a private customer. In 1891 the signal-service work, which forms the bulk of the telegraph custom of the government, was taken from the postmaster-general, and the secretary of agriculture was empowered to fix the rates.

400 Horse Power Induction Motor.

By Orrin E. Dunlap.

The Westinghouse Electric and Manufacturing company has recently installed in the station of the Buffalo and Niagara Falls Electric Light and Power company at Niagara Falls the largest motor of the Tesla induction type ever made. The new machine is of 400 horse power, and two of them are to be put in to take the place of the 300 horse power motors which have been in use. The service of the 300 horse power motors has been discontinued. It will be recalled that they were of the direct-current type. The installation of this new motor marks one of the very notable changes Manager Frank G. Lott is making in this station, which has such unexceptional facilities for operation. The new motor takes the current direct from the big dynamos in the power house of the Niagara Falls Power company at 2,000 volts. That the motor has many economical features will be quickly recognized. So far in its career it has given eminent satisfaction. The illustration presented herewith will give an excellent idea of the motor.



400 HORSE POWER INDUCTION MOTOR.

Bell People in Trouble in Tennessee.

The Cumberland Telephone and Telegraph company, a Bell licensee, is facing an unpleasant situation in Tennessee. It appears that some time ago an independent company went into the telephone business in Columbia, where the old company had been charging $4 a month for its service. The new company made a rate of about $1, and it is said that the Cumberland's list dropped so rapidly that it determined on active warfare, finally reducing its price for telephones to 50 cents a month. There is nothing unusual in these tactics; but in Tennessee there is a law which reads as follows:

"Every telephone company doing business within this state, and engaged in a general telephone business, shall supply all applicants for telephone connections and facilities without discrimination or partiality, provided such applicants comply or offer to comply with the reasonable regulations of the company; and no such company shall impose any condition or restriction upon any such applicant that are not imposed impartially upon all persons or companies in like situations, nor shall such company discriminate against any individual or company engaged in lawful business by requiring, as condition for furnishing such facilities, that they shall not be used in the business of the applicant or otherwise, under penalty of $100 for each day such company continues such discrimination and refuses such facilities after compliance or offer to comply with the reasonable regulations, and time to furnish the same has elapsed, to be recovered by the applicant whose application is so neglected or refused."

Residents of towns of about the same size as Columbia think that they are discriminated against, unless they, too, have 50-cent service. One hundred citizens in Brownsville, Lebanon, Gallatin, Pulaski and Murfreesboro respectively have addressed formal applications to the company for telephones at the rate of 50 cents a month, claiming that the several towns in which they live are in the same class with Columbia, and they are entitled, therefore, to rates as low as those enjoyed in Columbia. At present the rates in the towns mentioned range from $2 to $3. The applicants purpose waiting a reasonable time for the Cumberland people to comply. In case the company refuses, they will bring suit against the company for the forfeiture of $100 daily to each applicant so long as the company declines or fails to give the undiscriminating service.

There is prospect of trouble in Memphis also, where the rate for residence telephones is from $50 to $60 per year, or an average of nearly $5 per month. The rate charged in Memphis is about the same as that of the same company in Nashville, Chattanooga and Knoxville. When it became known in Memphis that the 50-cent rate had been made in Columbia, Messrs. Cary and Ewing, of the law firm of that name, acting for themselves, and for H. S. Spinning, H. C. Polk, W. T. Avery, G. M. Brasfield, W. C. Graves, Hunsdon Cary, T. B. Armistead and T. C. Guinee, made application for the use of telephones in their residences at the rate of 50 cents per month. Each application was made out as follows:

"To the Cumberland Telephone and Telegraph company, Memphis, Tennessee: I hereby apply for the use of a telephone in my residence at ————, city of Memphis, Tennessee, at 50 cents a month, the rate charged by your company at Columbia, Tenn., for similar service, and I state that I am ready and willing to comply with the reasonable regulations of your company in respect to the use of such telephone.

"This demand is made under and by virtue of section 1842 of Shannon's Code of Tennessee, and the forfeiture therein allowed will be claimed in the event of your refusal to comply herewith.

"This the 28th day of August, 1897.

"————————."

With the applications the attorneys sent a letter in which they stated that the forfeiture of $100 per day would be claimed as provided by law if the requests of the applicants were not granted. The telephone company has not yet given its answer to the applicants or to the letter of the attorneys.

Similar applications have been made in Nashville, and Mr. Ewing is in receipt of a letter from a prominent Nashville attorney, in which he states that a general fight will be made over the entire state for the 50-cent rate.

It is said that the telephone company has made the rate of 50 cents in Columbia for 12 months. If the company should wish to raise the rate in Columbia this contract must be broken, and if the rate is lowered in other places the loss would be great. It is estimated that the receipts of the telephone company in Memphis alone would be $23,000 less this year than last if the 50-cent rate were made for residence telephones. Should the company be made to pay the forfeit it would cost a very large sum.

Portable Telephone Outfit for Gold Hunters.

[From the Chicago Record, August 20th.]

Five young men, whose objective point is Alaska, will try the efficacy of electricity in keeping each informed of the actions and whereabouts of the others, while making efforts to locate paying claims in the mountains of the Yukon country. They are James H. Wilson, Henry C. Cary, John Collins, Edward Mills and John Lammy, the last two of St. Louis. Cary and Lammy are practical electricians and have been in the employ of the telephone companies of both Chicago and St. Louis.

Yesterday the men were purchasing the necessary supplies to open telephonic connections on a liberal scale, and early next week they will take passage for Dyea and attempt to get over the Chilkoot pass. Failing in this they will turn back to the Skagaway route, by which they believe that they will be able to get through.

The electrical supplies that the five men are taking into the northern country are intended for their own use. At the same time, the men expect to be able to turn a few extra dollars to their account by permitting others to use their service. They propose to travel together until they have reached some part of Alaska which gives promise of gold. Then they will plant a dry battery and run five wires from it. These wires are of the lightest of insulated copper, and each man will carry a spool sufficient to run him for a day or two while prospecting.

Each night the wires will be tapped and the transmitting instruments which the men carry will be attached. Then each man will tell the other of his success. As soon as one strikes a lead which gives promise of panning out well the others can be summoned, and each will be able to locate the find by following the right wire. In case neither finds a paying claim from the first battery "plan," they will all return, pack up their stores and move to some other point, where the same ceremony can be gone through with again.

The idea originated with Lammy, who several years ago was in Chicago and employed as a lineman by the telephone company. He communicated with Cary, and the other three were interested in the scheme. Collins is a machinist and Mills has had considerable experience as a miner, having been raised in California, and having worked for some time in the mines there. Lammy said yesterday:

"A man can easily carry enough wire to cover a distance of five or more miles, and besides affording him a means of direct communication it will be a guide for him back to his starting point and will insure him against being lost. Another advantage will be found in the fact that, in case of injury a member of our party will have it in his power to summon assistance. There will be nothing permanent about our telephone line, and we do not expect to start a service for commercial purposes, although we may gather in some small change from miners whom we meet in various parts of the country. Our intention is to prospect in a careful manner; that is, to cover the ground thoroughly, so that we may miss nothing. In case of a strike it will not require more than half a day to have all five of our party on the ground."

Telephones for Farmers.

[From the Chicago Chronicle.]

In this age of cheap application of electrical science to human need one is not surprised at the rapid extension of telephonic communication in the smaller towns and even villages of the country. Nor can we really affect surprise when we learn that the boon of cheap telephone exchanges is in a fair way of being extended in the purely rural districts. We are already informed that in Central Kansas there are a number of ranches connected by telephone with one another, enabling the owners and their families to enjoy intimate communication for both social and business purposes.

The Kansas plan is to utilize the little railroad station in the vicinity of the farming district as the "central" office and to connect the various farmhouses. A plan somewhat similar to the one described has been experimented with on some of the larger Nebraska ranches, and we are informed that wherever tried the success is so marked as to guarantee a rapid extension of the system through the rural districts. There is no mention as yet of any action by the large telephone trust in regard to patent infringements by the farmers, and probably such action, if taken, may be successfully resisted by one or more of the independent companies.

Why should the average farmer or his family be cut off from intercourse with neighbors or adjoining municipalities? It is probably a question of time when the farmers will have the benefit of free postal delivery, at least in the older settled neighborhoods, and it is but a step along the line of progress to telephonic communication at very slight expense to each rural subscriber. The saving of time and horseflesh, to say nothing of the increased facilities for business transactions, resulting from the introduction of farm telephones, renders it extremely probable that when once proved successful they will be extended as paying investments.

For the female members of the average rural household no words are too strong to picture the altered conditions of life that will ensue from the introduction of the telephone. Isolation is pro-

nounced by all sociologists the greatest bane of farming life and is probably responsible for more dwarfed womanhood than any other single cause. The telephone, for social reasons alone, will prove itself a benefactor to rural communities by exchanging for monotony and isolation the benefits which are already considered indispensable to urban dwellers.

Testimony Over Telephone.

There was a forcible illustration of the use that can be made of modern inventions in the Supreme Court late yesterday afternoon says the New York Evening Sun of August 26th, when an affidavit taken over the long-distance telephone wire between this city and Cincinnati was submitted to Justice Beekman in a suit for an attachment.

The suit in which the telephone affidavit played such an important part to save delay was one brought by Frank A. Rothier against George P. Altenburg of the Cincinnati firm of brokers and bankers of G. P. Altenburg & Co.

In his complaint, drawn by Horace E. Deming, the plaintiff alleges that on August 31, 1896, he deposited with Altenburg $2,200 to be invested in Western Union and other stocks.

It is charged in the complaint filed in the Supreme Court yesterday that the defendant never invested the money in any stocks, and has refused to return it. Counsel for Rothier desired to get an attachment yesterday against any property that Altenburg might have in this state, but to do so it was necessary to have the papers sworn to by the plaintiff, and as Mr. Rothier was not in this city, but in Cincinnati, counsel was somewhat perplexed as to how to proceed.

The papers filed in court show that the telephone was used successfully by the lawyers, and the attachment was secured without a delay of several days, as would have otherwise been necessary.

In his affidavit Joseph G. Dean, of counsel for the plaintiff, narrates how he learned by telephone from E. K. Stallo that Rothier was in Cincinnati. Mr. Dean was familiar with Mr. Stallo's voice and requested him to call Mr. Rothier to the telephone. The lawyer had a long conversation with Rothier, and the affidavit contains the following:

"I then read over the facts of the foregoing affidavit to said Rothier, and the gentleman made oath that he was the plaintiff and that the facts in the said affidavit were true, and I then made this affidavit."

Counsel then filed a bond for $250, and the attachment was issued by Justice Beekman.

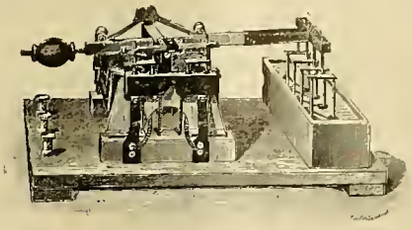
Where the Old Copper Goes.

An important industry, and one of especial interest to the electrical trade, is that which has for its object the refining and reclaiming of old brass and copper. In Chicago this work is done by the Swarts Metal Refining company of 20 North Desplaines street, and the picture gives an interior view of the company's plant. The company is always a purchaser of scrap copper wire, rail-bonds, burned-out armatures and other worn-out apparatus made of copper or brass. At the shop, wire of long lengths and in good condition is tested, rebound and sold as second-hand wire. All scrap brass and copper is refined and cast into ingots for brass foundries. After several years of experience the company has perfected a high grade "XXX metal" for the bearings of motors and other high-speed machinery. This babbitt has been tested with most satisfactory results. It is an amalgamation of pure tin, copper and antimony, each in its proper proportion, and will not heat or pound out. The company also manufactures high-grade bar and wire solder for electrical purposes. Another specialty is cotton and woolen waste in bales of 100 pounds and 500 pounds, a large supply of which is kept in stock for ready shipment. The officers of the company are Seymour Swarts, president, and Louis Schwab secretary.

WHERE THE OLD COPPER GOES.

Automatic Interrupter for High-tension Circuits.

This apparatus is worked by a feeble current furnished by a local battery, and consists of two electro-magnets which actuate a lever. The lever bears, at one of its extremities, a series of metal rods



AUTOMATIC INTERRUPTER FOR HIGH-TENSION CIRCUITS.

tipped with platinum which dip into a series of cups of mercury when the lever inclines to that side. The other extremity of the lever is provided with a counterpoise with lock screws for regulating the apparatus.

When the battery current is sent into one of the electro-magnets the armature is attracted and acts upon the beam of this balance, which is inclined in one direction, to the right, for instance, and the metal rods dip into the cups of mercury. These mercury cups are formed of a block of porcelain in which are holes insulated from one another and filled with mercury. As the first and last of these holes become connected—one with one of the poles of the primary current, and the other with one of the terminals of the transformer—every time the rods dip into these cups the primary current will be closed on the transformer. When, on the contrary, the battery current is sent into the opposite electro-magnet, the armature being attracted in a contrary direction, the lever inclines to the left, the rods are lifted out of the cups of mercury and the primary current is interrupted. Two catches are worked alternately by the same electro-magnets that move the lever. These catches, under the action of the electro-magnets, release the lever so as to leave it free at the moment when it is required to incline to the right or left, and afterward hold it, when it has reached the end of its movement, thus preventing the possibility of its returning to its original position. The current of the battery that works the electro-magnets is interrupted automatically after each oscillation of the lever, in order to avoid the exhaustion of the battery and to allow of a service of longer duration. Six Leclanché elements are sufficient to work the system.

This apparatus is particularly adapted to electric elevators, as it enables the primary current to be closed upon the transformers only during the time really required for their use. The manipulation of the cable closes the circuit of the battery on one of the electro-magnets of the apparatus, and the primary current being immediately established, the car ascends; the second manipulation of the cable again closes the circuit of the battery on the opposite electro-magnet, which this time, causing the lever of the interrupter to turn in the opposite direction, breaks the primary current and stops the car.

As this apparatus interrupts high-tension currents automatically and from a distance by cutting out the transformers, it will render great service wherever current is only employed at certain times, or as in the case of an engine or of electric lighting during certain hours or during the evening only, as it will avoid the continual expense of the transformers working without any load. By adding clockwork mechanism designed for the purpose, the primary current might be connected with the transformers only during the hours of lighting. The cut is reproduced from L'Industrie Electrique.

Two New Electrical Plants for Factory Transmission.

The Westinghouse Electric and Manufacturing company has just secured, through its Chicago office, a good contract from Swift & Co., the meat packers, for the complete electrical power equipment of the latter firm's new establishment at St. Joseph, Mo. All the machinery in the new packing house and slaughtering establishment will be electrically operated, and alternating current will be used. There will be two generators, of 180 and 250 kilowatts' capacity respectively, and these will supply at an electromotive force of 220 volts two-phase current to no less than 56 motors, ranging from one to 40 horse power.

A large addition to the Deering Harvester Works of Chicago is building, and its machinery will be electrically operated. Three-phase current at 550 volts will be generated by a 750 kilowatt dynamo installed on the premises and directly connected to a steam engine, probably of the horizontal Reynolds-Corliss type. The generator will be of the revolving field construction and will be driven at 110 revolutions per minute. It will supply current to 11 induction motors—eight of 75 horse power each and three of 50 horse power each. The contract, which has been awarded to the General Electric company, includes the switchboard. The motors will drive the twine and other machines used in the new factory.

Faith Cure Administered by Telegraph.

[From the St. Louis Globe-Democrat.]

Austin, Tex., August 24.—One of the most remarkable faith cures on record has just taken place here. Last week William Lockridge, a prominent merchant, was lying prostrated with paralysis of his lower limbs, which were so badly affected that they had to be lifted every time he turned in his bed. So critical was his condition that his family physician had given up all hope of his recovery. To-day he is walking about the streets, apparently as well as if he had never been crippled with the disease, and his recovery is attributed solely to his being treated by telegraphic direction within the last few days by a lady faith healer of Illinois.

Sunday evening Mr. Lockridge, who was speechless and so low that he seemed to take no notice of anything, intimated by means of his hand that he wanted a pencil and paper, with which he made known that he was feeling better. It was about this time the healer wired that she had begun her treatment. The patient had been sick nearly three months, during which time the paralysis had crept up his legs from his feet to his body as far as his waist. He is practically cured and is rejoicing with his family. He claimed to be well yesterday.

The facts are authentic, and the Globe-Democrat correspondent, who is acquainted with the family, can vouch for them.

Calculation of the Energy Loss in Armature Cores.[1]

By W. E. Goldsborough.

The paper discusses the character of the internal distribution of the magnetic flux in laminated iron cores. Experimental results are cited to show that the flux density, in a section of the core taken midway between the poles and parallel to the shaft, is much greater near the air-gap surface than near the inner periphery. When the armature is in motion this lack of even distribution is intensified, owing to the repelling force exerted by the eddy currents, magnetic sluggishness in the iron and the disturbing reaction of the armature currents.

The experimental results were obtained by threading insulated wires through a series of holes drilled in a laminated iron core; these served as exploring coils.

By taking the uneven distribution into account the calculated core losses agree with experimental determinations without the introduction of arbitrary constants into the formulæ.

Telephone Testimony in Kansas.

[From the Topeka State Journal.]

Fort Scott, August 23.—An innovation was introduced in the court here Saturday, when two witnesses were examined and gave their testimony over the wire. After the trial in the case was commenced two witnesses were wanted. Both were business men, and the attorneys for both sides agreed that to save time they should give their testimony by telephone, which was done. Affidavits have been sworn to and acknowledgments taken by telephone and sustained by the courts, but this is believed to be the first time that testimony has been received by 'phone.

1. Synopsis of paper presented before section D, A. A. A. S. Detroit, August 9-14, 1897.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 62 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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With the Niagara Falls convention number of the Western Electrician, dated June 12, 1897, this journal made a new record for itself both in circulation and advertising. Of this 100-page number 20,000 copies[1] were printed and circulated and the amount of full paid advertising matter carried was 8,643 square inches.

Beginning with the convention number of March 3, 1894, the record shows constant gains each year until in the present case the number of square inches of full paid advertising matter is more than double that of the 1894 number. The figures showing this unprecedented gain are given in the accompanying table:

Issue	Number of Advertising Pages.	Whole Number of Pages.	Square Inches of Paid Advertising Matter.
March 3, 1894	40	56	4,145
February 23, 1895	52	68	5,593
May 9, 1896	72	88	7,576
June 12, 1897	80	100	8,643

This constantly increasing patronage speaks eloquently of the influence and merit of this journal and of the confidence and respect which it commands throughout the country. It is pleasing recognition of the efforts that have been made in the interest of the entire fraternity.

Government inspectors in France continue to indulge in theatrical effects in the discharge of their duties. Complaint is made by travelers who carry photographic plates that they are destroyed by the X-ray customs examination. A correspondent gravely announces that "the authorities promise to take precautions, when possible, against damage by the new detective agent."

A newspaper dispatch from Cleveland, Ohio, announces that "four Ohio scientists have returned in anger from the congress of the British Association for the Advancement of Science at Toronto. They complain that they were completely snubbed by the members of the association and were made so uncomfortable that they started for home before the convention was two days old." The names of the "scientists" alluded to and their standing and achievements in the scientific world are made known through the same agency, but we refrain from divulging this information, as the disclosures might precipitate an international dispute.

The street railway companies of New Jersey are actively opposing the enforcement of the vestibule law, and the matter has been taken to the Supreme Court of the state for consideration. The New Jersey Legislature passed a law last winter which was intended to compel the Consolidated Traction company to run vestibule cars on its lines during the winter months, but the wording of the act was such that the requirement was for the summer instead of winter, and for this reason the Traction company will contend that the law is defective and unconstitutional. If the court decides the law to be invalid, another measure will probably be introduced in the next Legislature.

Since the discovery of carborundum the electric arc has been drawn into all sorts of experiments in the hands of the modern alchemists, who seek the formation of diamonds, etc., by the fusing of sundry earths or mineral ores, and some quite curious results have followed.

For a long time the mineral bauxite has been calcined, producing a very hard grinding material for dressing millstones. Then the idea took possession of M. Gin, a distinguished engineer and inventor, of volatilizing aluminum, and combining its red fumes with other vapors, and watching the result. M. Gin in this way started the wholesale manufacture of rubies, not by the handful, but by tone!

M. Gin asked a patent of the German government. The Patent Office doubted, smoked, and shrugged its shoulders, metaphorically, and asked for a sample of the manufactured article, expecting probably a trifle or two from the laboratory.

M. Gin was a little mischievous, or wild with joy, for he sent in answer to Berlin a box of rubies, and an enormous block—one monster manufactured ruby. The patent papers came by return mail; but the ruby as a gem has probably seen its best days.

"Passengers asserted that the motorman was not to blame, as it was impossible to stop the car," is the conclusion of a paragraph in a daily newspaper detailing an accident on a suburban electric line in which an infant was thrown from a carriage and killed. The circumstances as related do not justify this conclusion. With an open line and no obstruction to the view of the track, the car properly equipped and operating at a reasonable rate of speed, the motorman should have been able to stop the car and avert the accident. The responsibility of motormen is great, and none but thoroughly reliable men should be accepted for such positions. A little more care in the selection of employes might well be exercised by many operating companies.

The Englewood and Chicago Electric Street Railway company, operating "the only electric storage battery street railway line in the country," has issued a neat folder setting forth the attractions to be found along its line and making an appeal for the business of the pleasure-traveling public of Chicago. The idea of following the advertising methods of the passenger departments of steam railroad companies is a good one for suburban electric railway companies, and is being taken up quite extensively. However, it was hardly necessary, in the present instance, to make an attack on the trolley system, as is done in terms following: "With the advent of the electric storage battery and its application to street cars, great inroads are being made upon the introduction of the trolley system, and the gradual retirement of the latter will soon be an accomplished fact. The great danger and unsightliness of the trolley, with its overhead wires and poles, together with the great danger to life and liability of fire along the line of the road, will ultimately drive this system out of our city streets, and the advantages of the storage battery system will gradually bring that method into prominence." These statements are certainly exaggerated, if not altogether untrue, and they should have had no place in the literature of an electric street railway company.

The commissioner of public works proposes to relieve the downtown business district of Chicago by removing tracks from several streets and establishing a surface loop for the use of the cars on the lines affected. From what Mr. McGann has said of his scheme, it appears that he is going to ask the Yerkes system to use only two bridges to the North Side and two bridges to the West Side, and operate downtown only on Fifth avenue, Van Buren street, Wabash avenue and Washington street, making one big loop five blocks square, with double tracks, one to be used exclusively by West Chicago and the other by North Chicago lines. The Yerkes system now occupies Fifth avenue, Van Buren, Washington, Madison, La Salle, Dearborn, Adams, Clark and Lake streets in the downtown district, and it will be seen that in accepting the proposition of the commissioner, Mr. Yerkes would be making all the concession. It will be seen, too, that at present Mr. Yerkes has franchises on all the streets covered by Mr. McGann's proposed loop, with the exception of Wabash avenue. That street is occupied by the Chicago City Railway company and is double-tracked over all that part which Mr. McGann's loop would cover. The best that can be said of this plan is that it may temporarily relieve certain districts which are now greatly congested, but there are so many objections to the scheme that its adoption can hardly be mentioned among the remotest possibilities. It is a weak adaptation of the elevated loop idea to surface railway lines, and as the conditions under which surface and elevated roads are operated are entirely different, it is hard to understand how Mr. McGann can hope for the adoption of his plan. A comprehensive subway system, taking the place of all the surface lines, would afford permanent relief to the crowded district, but it would be very expensive, and as the street railway franchises are about to expire, the companies would probably oppose such a scheme unless they were assured of 50-year extensions of their franchises, at least.

1. State of Illinois, County of Cook—ss:
Thomas Jansen, being duly sworn, deposes and says that he is a resident of the city of Chicago, in the county of Cook and state of Illinois, and that he is the foreman of the printing department of the Electrician Publishing company, the publishers of the Western Electrician; that he was present at and superintended the printing of No. 24 of Vol. 20 of the Western Electrician, issued on June 12, 1897, and that there were printed by actual count 20,000 complete copies of said Western Electrician of the volume and number above specified. And further this affiant sayeth not.

THOMAS JANSEN.

Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

American Engineers and English Railway Projects.

English electrical engineers seem to be greatly exercised over the announcement that an American engineer might be retained by the Liverpool corporation in the electric railway project now under consideration. The London Electrical Review, under the heading, "No Need to Go Abroad," leads the attack on the proposed arrangement as follows:

"One of the daily newspapers is our authority for the statement that Sir A. B. Forwood has resigned the chairmanship of the Liverpool City Council tramways committee because of an adverse vote in regard to the committee's proposal to engage an American engineer for carrying out and supervising the work on the experimental trolley line section to be shortly equipped. If this be the case, we think that the Liverpool City Council has shown a good deal of common sense and fairness. No reasonable Englishman wishes for the days of protection to return, and we are as strong free traders as anyone could wish to be; but when there are engineers in this country of professional standing, such as Professor Kennedy or Dr. Hopkinson, and manufacturers of world-wide repute, we don't need to go across the Atlantic for a consulting engineer who shall be capable of carrying out a complete electric tramway system. There are many directions, as, for instance, the design and manufacture of tramcar motors and controllers, in which we acknowledge American supremacy, and in these we are glad to avail ourselves of Brother Jonathan's experience (of course paying for it), but to call in a consultant from the other side is rather too much of a good thing. The Dingley tariff is hardly likely to encourage the average Englishman to shower benefits unnecessarily upon America. Of course, we have not a word to say against the elect of Liverpool's tramway committee; far from that, for Mr. Pearson (we understand it is he) must have by now acquired such a mass of traction experience as few others possess. Yet it must be remembered that his skill and knowledge deal with conditions as they are found across the Atlantic, and these are not by any means necessarily the same as rule at Liverpool or elsewhere in this country. Apart from that, however, we protest against the committee asking for powers to engage Mr. Pearson as an expert, if only on the ground that there are competent Englishmen ready to undertake the work, and in overruling this proposal of the committee the City Council is to be congratulated. We are surprised that the chairman of the committee should have taken such a course as that of resignation; a step of this kind savors too much of pique, which ought hardly to enter into an important municipal question. In any case it should not be regarded as a marked want of confidence for the council to reject a part of the committee's proposal, especially when patriotism is the cause. For the council to give way now would put it in the position of yielding against its better judgment, in order to avoid unpleasantness."

Americans will find it difficult to understand just where "free trade," "protection" and "patriotism" enter into this problem. The English idea is concisely expressed by the Review in this admission:

"We are glad to avail ourselves of Brother Jonathan's experience, but to call in a consultant from the other side is rather too much of a good thing."

In other words, John Bull, who prides himself upon his fairness, wishes to appropriate American ideas, gain all the advantages of American experience, borrow American designs for apparatus, but give all the credit for the enterprise to some English engineer who has had absolutely no experience whatever in this line of work. That is essentially a "fair-minded" Englishman's idea of equity.

The London Electrical Engineer contributes the following to the controversy:

"We think it only just to the profession generally to protest against the proposed appointment of a foreign engineer to advise the Liverpool corporation over their traction work. We do so not from any personal motives, as we are convinced that Mr. Pearson is well qualified to carry out the work, and that he would use his best endeavors to make the same a thorough success. What we do say most emphatically is that we have many consulting engineers in England who are quite as capable from a technical point of view, and who, both from their residence here and their knowledge of English municipal practice, should not be lightly passed over. The fact that we have not had so many lines laid down on this side is the fault, not of our engineers, but of that of our democratic tramway laws; and we would say unreservedly that the English lines equipped by English engineers are not behind the American practice in any way. Perhaps one reason for this may be gathered from the fact that here we are not in the hands of the contracting firms, who in America control the industry. In other words, the English consulting engineer does design the work to suit the locality, whereas much of the work carried out on the other side is on the standard system. If the standard system does not suit the locality, so much the worse for the local people. Something beyond giving an order for so many miles of track with all needful gear is considered necessary here, and the fact that the General Electric company can dispatch tramways much as some grocers fulfill their weekly orders is not in our eyes a recommendation to the professional skill of the resident engineers. We put this to the Liverpool people as a reason for considering before finally committing themselves to the report of the tramway committee, and trust that the corporation will decide that English tramway experts should have a large voice in the electrical traction schemes they are proposing. They cannot plead a want of knowledge, as the Liverpool overhead railway is a practical example of what original thought and careful design has accomplished."

The absurdity of the position taken by the English engineers could not be set forth more plainly than in this assumption of knowledge and experience. Their claims to originality in design and the advantages of their methods of adaptation to suit the conditions of the locality appear ridiculous to those familiar with the work that has been done by these "English tramway experts." There is not a single feature in their work that is not taken from the American "standard system," which the English engineers affect to despise. The much vaunted superiority of English methods over American practice has been amply illustrated in the work of George Forbes, the champion controversial engineer of the British Empire.

Universal Alternator for Laboratory Purposes.[1]

By Henry S. Carhart.

The design of the machine was adopted for the following reasons:

1. Simplicity of construction in the engineering shops without tools or dies.

2. Its similarity to a bipolar dynamo, so as to illustrate two or three-phase current generation, but without the limitation to low frequency.

3. To illustrate the effect of combining electromotive forces differing in phase in a variety of ways.

Both the field and the armature are made with poles, the latter having two more than the former. The field is the revolving member and is of the C. E. L. Brown type. The diameter of the armature pole faces is 10.25 inches; length of poles, four inches; width of poles, 1.5 inches; depth, 0.5 inch. The armature poles were wound with 40 turns of No. 16 wire. The double air-gap is 0.25 inch. The field coil contains 1,012 turns of No. 16 wire. The armature coils were connected in pairs and the terminals of each pair are brought up to a board on top.

Since opposite poles of the field are of opposite sign, while the corresponding coils of the armature are similarly wound, when the armature is connected as a closed coil the electromotive forces balance exactly as with a bipolar machine. Hence connections may be made for two or three phase, as with a bipolar dynamo.

The coils may also be joined either in star fashion or zigzag across, so as to join opposite groups with no phase difference between them.

The phase difference from coil to coil is one-twelfth of a period. Hence the series may be represented by a regular polygon of 12 sides, and the phase difference reduces the electromotive force of the six coils in series to 0.643 of the electromotive force without such phase difference.

With 2,000 ampere-turns in the field, the following are the observed and computed values of the voltage for the several connections:

Connection.	Observed.	Computed.
Two-phase mesh	79	79
Two-phase star	112	112
Three-phase mesh	69	68.6
Three-phase star	121	118.8
Three-phase zigzag	136	136.8

Effect of Governmental Ownership.

What with threatened strikes and parliamentary inquiries the state telegraph system of Great Britain has come upon troublous times. A correspondent states that when Parliament meets again in England attention is to be drawn to the unprecedented manner in which private telegrams have been seized and made public during the recent South African investigation at Westminster. There was so much protest raised in Parliament years ago when Mazzini's correspondence was opened and examined by the authorities, that it seems strange that so many weeks should have been allowed to elapse before anything was heard about the violation by the government of private telegraphic correspondence. The Postoffice Department is just as much bound to observe the sanctity of correspondence by wire intrusted to its charge for transmission as correspondence by letter.

American Street Railway Association.

So great has been the demand for space for exhibition purposes at the Niagara Falls convention of the American Street Railway association that it has been found necessary to revise the original plans and make provision for an additional 2,500 feet, and even this will not meet all the requisitions that have been made, although 11,851 feet has already been allotted. The officers of the association claim that they could use at least 5,000 feet additional room if they could obtain it. Everything indicates that this will be the largest meeting that has ever been held by the association.

1. Synopsis of paper presented before Section D, A. A. A. S., Detroit, August 9-14, 1897.

Electrical Development in England and France Compared with American Practice.

By J. McGhie.

The outcome of a hurried visit to England and France is, perhaps, not so much the acquisition of the idea that both of these counties are hopelessly behind in the race, electrically speaking, with the enlightened sons of Uncle Sam, as the receipt of a very strong impression that they are much farther ahead than we have been led to suppose from the reports of the veracious foreign correspondents of the daily press. True it is that electricity has by no means become the handmaiden of daily home and business life, as it has on this side of the Atlantic, but, freed from the bumble-like restrictions placed upon its adaptation by sundry parliamentary wiseacres in the early eighties, when the industry needed most encouragement, it promises to become as widespread in its use in the United Kingdom as here in the United States. The period through which this country passed some eight years ago, when the boom of electricity in the lighting as well as in the railway branches enveloped every town and hamlet, has for some time dawned in Great Britain and France, and there is plainly evident a marked avidity to acquire as soon as possible a better means of illumination than is afforded by very poor and very poisonous gas, and a better method of transit than the poorer horse and the hearse-like tramcar.

The lack of private initiative, however, which has prevailed during the last few years, is strikingly apparent. Under the governmental restrictions imposed upon it, electricity as a field for investment presented few or no inducements to capital, and where, in the United States, thousands of dollars were poured out for the purpose of installing stations and spreading the use of the current, it seems to the ordinary observer that in England and France pennies only have been invested, and those with a niggardly hand and suspicious mind. The confidence in the future universal use of electricity which characterized the pioneers on this side seems to have been almost entirely absent from the minds of the men on the other; and that which is here termed European conservatism is simply either a pure lack of appreciation on the part of the English or French, or a determination to do nothing until, by the experience gained in the United States, capital could see its way clear to the assurance of a profitable return. Any lack of appreciation, however, is rapidly giving way before the active propaganda now being carried on. Indeed, it may be said to have already made way for a very lively realization of the positive benefits to be derived from the use of electricity—a realization of which certain American companies, with an eye kept vigilantly open for future business in Europe, have already taken advantage.

To glance over the list of projected companies having the utilization of electricity as a basis for their appeal to the public, in England, that country of easy flotations, is calculated to make one believe that the electrical millenium is near at hand. Hardly a city or town, however important, or a Little Peddlington, however insignificant, but is desirous of having a station within its limits, and if the public were as sanguine as the promoters, there is little doubt that the boom of electricity would assume overwhelming dimensions. It is, perhaps, fortunate that the mysterious je ne sais quoi which to the untutored envelops all things electrical is still unpenetrated by the general public, otherwise England would probably see another panic such as was caused by the collapse of the great boom in the early days of railroads. In view of this an immediate, widespread extension may not, therefore, be looked for, but instead, a healthier, steady and cautious increase.

It is not until the visitor has left Liverpool, when he lands, that the still chary use of electricity makes itself felt. The first impression gained from a view of and a trip over the Liverpool overhead railway, is that he has dropped among a distinctly electrical people. Here is a road which enjoys the distinction of being the first permanent elevated electric railroad in the world, between six and seven miles long, running the entire length of the magnificent estate of the Mersey Docks and Harbor Board, from the Dingle to Seaforth. It is run without hitch or accident, and traveling upon it is a distinct pleasure. The road is phenomenally smooth and the perfect manner in which the train service is carried on is a delight. Although this road was installed in 1893, and was preceded and followed by important subterranean electric railroads in London, it is a strange fact that comparatively slow progress has been made in the adaptation of the electric motor to the street railway systems. It is as though the country had paused for breath after the exertion.

After leaving Liverpool electrical installations of all kinds become markedly sporadic. Electric lighting is still a luxury to be enjoyed with the pride of possession, or gingerly with the satisfaction that comes of playing with a half-understood and dangerous plaything. The pushing little private company, securing with a hurrah and the expenditure of a little palm money a franchise for nothing from a venal or semi-venal board of aldermen, is practically unknown. The installation of an electric lighting plant is a matter of grave concern to be approached with a seriousness befitting the case.

And here is appearent the extent to which municipal socialism has crept into English city life. A large number of the electric lighting plants concerned with city lighting which have been installed are not private, but municipal, owned by the city or town and operated by the corporation officials. To the American imbued with the knowledge gained from hard experience—that any municipal plant would prove a municipal curse in the hands of the politicians—this ownership and operation of electric lighting plants by the cities themselves is a source of wonder by no means diminished by a visit to the station and an examination of the accounts. It may be the thin edge of the socialistic wedge leading to eventual universal state ownership, but so far as England is concerned the apparent results are gratifying. The process by which these are obtained is simple. The decision to acquire or establish a plant by a municipality is followed by the retention of the most talented consulting engineer it can afford—such men as Dr. John Hopkinson and Professor Kennedy, for example—and the advice of this engineer is followed and not set aside for that of some man with a pull. The estimates are honestly called for and honestly treated, and the result is, without exception, the purchase of the best available machinery the town can pay for. The deliberation accorded the project, though to us somewhat slow, receives its compensation in the perfection of the result achieved. The erection of the plant is followed by the engagement of a competent operating engineer, and on his appointment the role played by "inflooence" is very minor. It is not a political position to be given away as compensation for value received, and it is held so long as the incumbent behaves himself. There is no dismissal on account of political differences and no retention on account of political services. The same rule applies to all the positions connected with the station. The net result of the injection of a little honesty into these municipal matters is a plant which is the pride of the taxpayer instead of a yawning gulf of expense.

The impression gained from a visit to English or French central stations is essentially agreeable. Instead of a station containing half a dozen different makes of dynamos, some driven by belt and some directly connected, with a switchboard on which all makes of instruments are descernible—a station which has grown up with experience of a costly interest-devouring nature, a concrete history of the development of the art, so frequently found here, the despair of the manager and the haunting bête noire of sundry shareholders—one finds a perfect whole, carefully designed and executed with thoroughness. One is not confronted with the "O it'll do" earmarks of expediency. It is usually a consistent installation throughout. Indeed, there are but few stations in America which can compare in finish of detail, symmetry and general perfection with some of the recent installations which I had the pleasure of seeing in England and France. It should be remembered, however, that both these countries have profited largely by our experience, and perhaps I may be giving them too much credit for avoiding the rocks and shoals which we encountered in our pioneer work. We have the apparatus, but do not seem to dwell largely enough upon the necessity of absolute thoroughness throughout the station. At the stations of Croydon, near London, and Versailles, near Paris, the cleanliness, neatness and general consistency is noteworthy, and yet in each of these stations apparatus of American make alone is used.

One striking difference between English and American practice lies in the willingness with which the manager of an English station will give another valuable information regarding his experiences with his own plant. Here, our managers, outside the Edison fold, are as silent as carp regarding their methods of management, economies induced and results achieved. They are "giving away no wrinkles" to the other fellow. He might some day become a competitor. He never does, but silence is golden. And thus much useful knowledge is withheld.

As I said before, electric lighting is still a luxury. This remark applies more strongly to the use of the current in houses and stores. Street lighting by electricity is becoming very general in both countries, and both London and Paris have now very creditable services. During the past two or three years the incandescent lamp has had an arduous struggle against the mantle gas burner, the application of which did not necessitate the cost of a wiring installation, but it affords me pleasure to say that this light has been found so trying that it is rapidly dwindling in popularity. This assurance has been given me by lighting station managers who have felt the competition. In France, where the gas companies are more powerful, the mantle gas burner is still a very active competitor. An excellent indication of the increasing use of electricity for lighting purposes lies in the fact that the manufacturers of gas fixtures are now turning out large quantities of fixtures wired for incandescent lamps. Such an increase can only have had one cause—the increased use of the current.

The business in electrical appliances and supplies is healthy of tone, and manufacturers are crowded with orders. English and French appliances are, as a rule, made with a little less utilitarian aspect than are ours. Their snap switches, fuse holders, cut-outs, etc., are not so homely. There exists a desire to render them artistic, and they can thus be used in places where our rosettes, cut-outs, etc., would need boxes to hide them in. American manufacturers of lighting supplies, before entering into competition with English manufacturers, would perhaps do well to study carefully the character of the demand before attempting to press upon the market the appliances which are accepted here. I noticed in many stations that American measuring and indicating instruments, as well as recording wattmeters, were used. To my inquiries I received replies very flattering to the manufacturers.

The most marked advance electrically made during the last two years in England and France is in the railroad field. The urgent demand is for an improved method of traction, and both countries are in a position similar to that in which this country found itself in the early nineties. The improved method must be electric. Cable traction is now considered out of date, so far as rapid transit is concerned. Compressed-air traction is the laughing stock of all street railway engineers and managers. Compressed air has been played upon the trans-Atlantic public altogether too often, and mention of the compressed-air car experiments in New York, in the presence of English, French or German engineers, usually provokes a smile of pity for those furnishing the money for the experiments. They have long ago passed that point in Europe.

Electric traction is, therefore, the order of the day. The success of the trolley roads in Bristol, Birmingham, Dublin, Coventry, Lyons, Marseilles, Havre and those in Germany is the common incentive to reform elsewhere, and the change is sure to come and quickly. The municipal authorities of Glasgow and Liverpool have practically decided upon the use of electricity in lieu of horses, and this is not surprising when such competent men as F. S. Pearson, the chief engineer of the Metropolitan Street Railway company of New York, can embody in their reports such assurances as the following, extracted from the report presented to the municipal committee appointed to examine into the question at Liverpool:

"Mr. Pearson in his report states that he estimates the cost of operation per car per mile as follows:

System.	Cost of operation per car-mile.	Cost of operation per year on the basis of 130,000 car-miles per mile of track.
Overhead trolley	3.68 pence	£138,000
Slotted conduit	4.00 pence	150,000
Compressed air	5.02 pence	188,250

"As compared with these figures, Sir David Radcliffe stated that on the same date the present cost of horse traction is 7.19 pence per car-mile, and the cost of operation per year £269,625."

The field for electric traction in England and France is large, but it should be borne in mind that in England, at least, a large number of the tramway companies' charters carry the municipal purchasing clauses, and that committees and not individuals will have to be dealt with. Furthermore, electric railway apparatus cannot be sold upon "wind." Neither Englishmen nor Frenchmen will purchase apparatus on the mere ipse dixit of an American manufacturer, and in both countries guarantees have an unpleasant knack of being enforced by the courts. If American apparatus is to make its way in England and France, it must emerge successfully from the tests which will be applied to it, and manufacturers must be prepared to find the guarantee severe in its conditions—and it will not be possible easily to buy the cancellation of the guarantee.

One thing more: Americans should realize that they have to live down considerable odium caused by the super-smartness of certain of their compatriots in former days. The English and French have been gulled on many occasions, and to term a device American implies with them a quality of second-rateness extremely galling to the sensitive American. Bearing this in mind, the American manufacturer should be able to sell goods in England. He has no tariff to act as a deterrent, and provided his products are up to the standard success should meet his efforts.

The Trolley Stage Coach.

To operate electric carriages over ordinary roads without accumulators, a system has been devised and is said to be in operation in Greenwich, Conn. It is intended especially for stage routes, and is styled the "electric trolley stage." Conducting wires are strung on poles along the side of the road, a complete metallic circuit being used. A flexible cable gives connection with the carriage motor, and the vehicle is thus propelled over the highway without the use of rails. A descriptive writer says: "The device by which the trolley is conducted along the circuit wire is very ingenious, and it is this which, perhaps, constitutes the most valuable feature of the invention. The problem which Mr. Van Hoevenbergh [the inventor] had to solve was to devise some means whereby two trolley vehicles might pass each other readily, and whereby each might turn around and pass from one side of the road to the other. As finally designed, the contact device consists of a set of rollers attached to either of the main circuit wires, and so guarded that it will not fall off, or 'run away' when the vehicle is descending a hill. For vehicles which are passing in one direction, say south, for instance, the trolley rollers are attached to the inner wire, or the one next the sidewalk, while vehicles passing to the north feed from the outside wire. With a little care the motormen of the vehicles passing in opposite directions may manipulate their trolley wires so as to avoid any possibility of confusion. It is this facility of movement and control which will, no doubt, prove a very valuable feature of the electric stage. The arrangement of the rollers and connecting wires is such as to permit of the stage being run in either direction at will, and of being turned around, and of crossing from one side of the road to the other, as if it were drawn by horses."

Association of Edison Illuminating Companies.

The eighteenth annual convention of the Association of Edison Illuminating Companies will be held at the Cataract House, Niagara Falls, beginning on September 14th, and continuing through three days. The organization is composed of the Edison electric illuminating companies of the country which operate under licenses from the old Edison Electric Light company of New York, the corporation that supplied Mr. Edison with funds for his experiments and which owned all his patents for electric light, heat and power. At the present time the officers of the association are: President, Samuel Insull of Chicago; vice-president, R. R. Bowker of New York; secretary, W. S. Barstow of Brooklyn, and treasurer, J. W. Lieb, Jr., of New York. C. L. Edgar of Boston is chairman of the executive committee, the other members being Alexander Dow, Detroit; J. H. Vail, Philadelphia; G. R. Stetson, New Bedford; A. W. Field, Columbus, and ex-officio the officers already mentioned.

The convention will hold two sessions each day, morning and evening, and the afternoons will be devoted to visiting the scenic and electrical attractions about Niagara Falls. Only members of the association will be admitted to the meetings of the organization, which are always held behind closed doors, and the proceedings of which are strictly guarded. The organization has never published any of the papers read at these meetings, and has been very severely criticised because of this policy, as it has thus withheld from the public many valuable contributions to electrical literature. The attendance at the meetings of the organization is composed exclusively of officials of the Edison illuminating companies, of whom about 150 will be present at the Niagara meeting. This body naturally includes the oldest men who are now engaged in the electrical illuminating business. There is no associate membership of any kind, but on the occasion of the Niagara meeting it is expected that there will be a large number of former Edison men in attendance.

The proceedings of the convention will be opened with an address by President Insull, who, through his identification with the Edison interests from the earliest days, is undoubtedly better qualified to speak of the expansion and development of Edison central station work than any other man in the country. Among the technical papers to be presented will be one on methods of charging customers for electric current, by J. W. Lieb, general manager of the Edison Illuminating company of New York. Another, prepared under the direction of C. L. Edgar, vice-president of the Edison Electric Illuminating company of Boston, will deal with the use of storage battereis in connection with central station work. L. A. Ferguson, general superintendent of the Chicago Edison company, has prepared a paper on the economical distribution of electric current, and George R. Stetson, of the Gas and Edison Light company of New Bedford, Mass., will contribute some interesting information upon photometric measurements.

Probably the most interesting feature of the Niagara meeting will be the discussion of the relations between the members of the organization and the parent company, the old Edison Electric Light company, which is now owned by the General Electric company. The subject of the lamp supply, the contract for which has been made since the last meeting of the association, will be carefully considered in this connection.

Through the influence of President Insull, a large number of the pioneers in the Edison business have been induced to take an interest in the Niagara meeting, and several have given personal assurance that they will attend. It is expected that a large number of what may be called the original Edison men, that is, the men who were identified with the development of the Edison interests in the early days, will be on hand. This meeting will unquestionably be the largest gathering in the history of the association.

The London Electric Cab company's service was opened by W. H. Preece recently. In a long speech Mr. Preece referred humorously to the unmechanical construction and unscientific method of locomotion of the horse, and to the superiority of the electric motor in this respect. He recalled the fact that in 1881 300 pounds weight of batteries was necessary for the storage of a Board of Trade unit, whereas this quantity of energy was stored by 100 pounds weight of the batteries used in the new cabs. He had now under test at the postoffice cells which promised to give still better results. Fourteen electric cabs are plying for hire in the London streets as ordinary licensed hackney carriages.

A Mild Criticism.

A book was recently published in England with the title "Some Unrecognized Laws of Nature; An Inquiry Into the Causes of Physical Phenomena, with Special Reference to Gravitation." The title is pretentious, and the book was issued from the press of the printer to the University of Oxford. But the Electrician of London says that it is filled with scientific rubbish, although written in good style by men who seem to have received the conventional education. The review is very caustic, and one cannot but sympathize with the prevailing idea of rebuke to "educated" dabblers in technical matters, although perhaps the language is unnecessarily severe. These are the concluding paragraphs of the critique:

"The reviews in the daily and literary press have given no sufficient indication of the atrocious quality of the nonsense perpetrated in this pretentious book. The authors permit themselves to criticize dicta of Helmholtz and other leaders of science, denouncing them as absurd and erroneous, with the utmost freedom; and we suppose that to the British public the word of these self-constituted critics is as good as that of anybody else. The book is a sign of the times. It is an indication of what a feeble hold the real truths of science have and must necessarily have upon the ignorant public. As we have so often insisted, so long as schools and public education generally remain what they have been in the past, it only needs the death of a comparatively few individuals in order to loosen the grip of the human race on natural knowledge and plunge it back into the picturesque mediævalism so congenial to the mind of the average man.

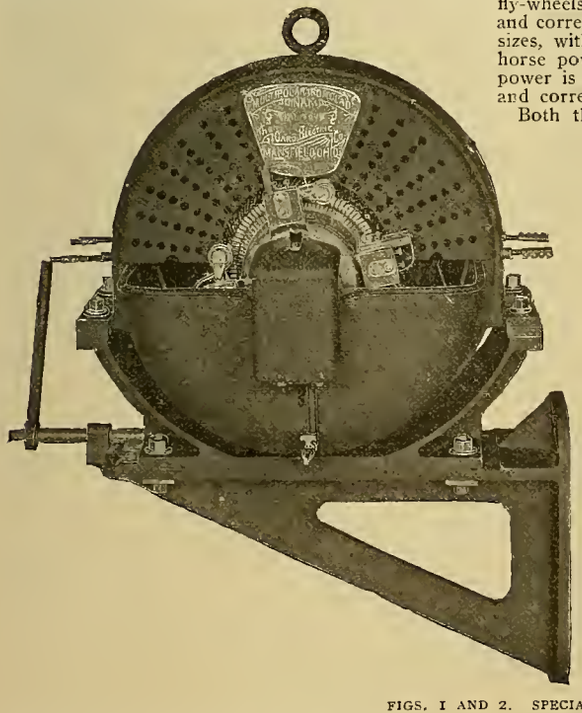
"We cannot help thinking that in any other country such a book would have appeared, if at all, in a bare paper form at the expense of the authors, and would be promptly ignored; whereas, here is a volume fit for any library shelves, reputably published and printed, written in fair style, illustrated by quotations which show no lack of what is called education on the part of its authors, and nevertheless full of balderdash from beginning to end. We are thankful that few of our so-called educated men feel called upon to write a treatise on science; it is bad enough to have to explain things to them, but when they begin explaining things to us, when the man in the street sets himself up as an authority on the philosophy of science, the result is well illustrated in the work before us."

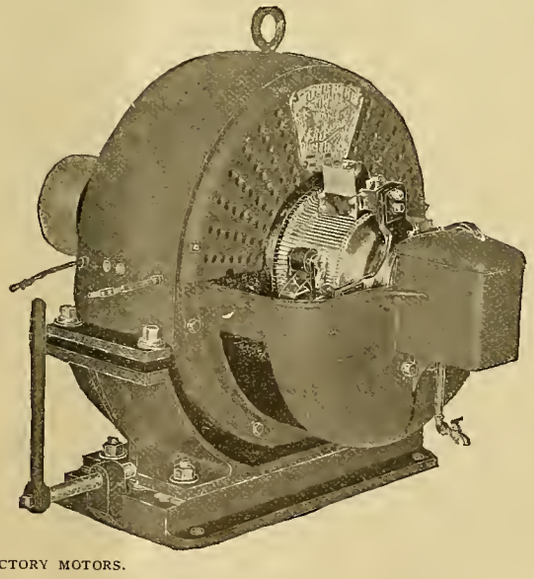
Special Factory Motors.

The rapidly growing demand for motors for machine shops and factories to drive tools and machinery of all kinds, and the confidence in their reliability and durability which has resulted from their successful use in the past, has created a call for special designs which will permit of their being put, without much additional cost, in out-of-the-way places, so as to occupy little room and, if possible, no floor space at all. To meet this demand the Card Electric company of Mansfield, Ohio, has brought out the motor shown in the accompanying cuts (known as the S type), which can be set on the floor, or supported from a post or wall, or suspended from the ceiling.

Fig. 1 shows the motor with a bracket support for fastening to a post or wall. By changing the position of the armature bearings—i. e., turning them one-half round on the pole frame—the bracket will be brought above the motor, which will then hang down. When the driving belt is to run horizontally from the motor, or nearly so, this style of support is desirable, since the belt-tightening screw is in the best position for quick adjustment.

The style of base shown in Fig. 2 is adapted to support the motor on the floor, as shown in the cut, or, by changing the position of the armature bearings, in order to keep the oil boxes right side up, from the wall or ceiling; and when the belt is to run nearly vertical this style of base is better than the bracket for wall support because of the better position of the belt-tightening screw. It is obvious that these motors can be used to drive shafting by gears as well as by belts, when it is desirable to do so. As motors of this kind are frequently fastened to iron girders or posts in buildings, and therefore grounded, protection to the armature and field coils is provided in the construction by heavy insulation between the pole frame and base. In all other ways care has been taken to insure rigidity and lasting qualities. These motors are made in sizes up to 15 horse power.

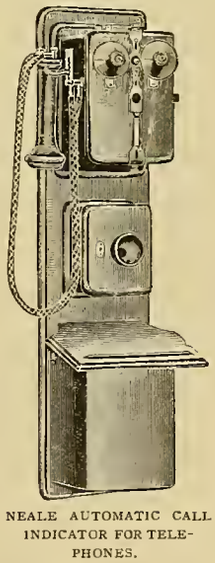




FIGS. 1 AND 2. SPECIAL FACTORY MOTORS.

Neale Automatic Call Indicator for Telephones.

The cut shows an ordinary telephone, to the bell-box of which is fastened the new Neale automatic call indicator and circuit-closing attachment. This device is made by the Climax Novelty company of New Bethlehem, Pa., and its purpose is indicated by the name given to it. It works independent of the line circuit, and gives a visual signal that announces that the telephone has been called during the absence of the user or his clerk. A hole in the indicator fits over the hammer of the telephone bell, and the device may be adjusted to fit any bell-box. When the hammer begins to vibrate a leaf falls, giving the visual signal and coming in contact with an insulated tongue, closing the circuit.



NEALE AUTOMATIC CALL INDICATOR FOR TELEPHONES.

Prouty Electro-gasoline Engine.

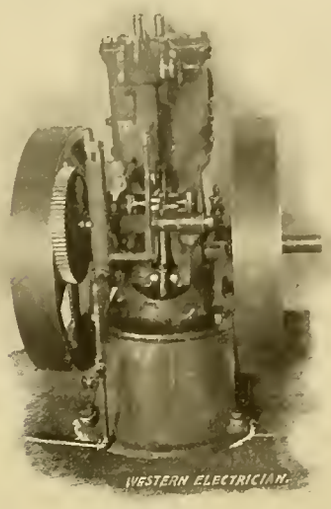
The picture is a reproduction of a photograph taken from a four horse power Prouty gasoline engine, made by the Prouty company of 79 Dearborn street, Chicago, which builds a number of different sizes, which are identical, except in larger or smaller corresponding proportions. The two and four horse power are 18 inches from crank-shaft to top of cylinder; the six and eight horse power, 24 inches; the 12 and 15 horse power, 36 inches, and the 20 and 25 horse power, 48 inches from crank-shaft to top of cylinder.

The sub-base is used on stationary engines, but is omitted on marine, portable, street-car, road-wagon and traction engines. The size of upper base on the four horse power engine is 12 by 16 inches and the sub-base 14 by 26 inches, and other bases correspond to the larger sizes. The diameter of the fly-wheels on the four horse power is 24 inches, and corresponding dimensions are kept on the other sizes, with an average weight of 50 pounds to the horse power. The total weight of the four horse power is within 500 pounds, without the sub-base, and corresponds in the other sizes,

Both the intake and exhaust poppet valves are located in the projecting chamber at top of cylinder in front, and the cold air alternately passing over them protects them from scaling. The gasoline is projected with great force against the intake valve from within the vertical tube suspended from the valve chamber through the vertical pipe seen below, in which is a lock cut-off, preventing the escape of any except the exact amount determined by the action of the plunger seen at the left, which is controlled in turn by the governor located in the disk of the gear. By this process the proportion of gasoline and air is determined exactly to the given pressure, producing a perfect gas mixture, which is followed logically by perfect combustion, giving the greatest percentage of power. The manufacturer claims that there are no offensive odors; that the engine cylinder and valves are never fouled, and that the working of the engine is never affected by rocking in a boat or jolting on a wagon or car.

The electric ignition is effected in the valve chamber by self-cleaning contact points, which are kept from overheating by the alternate action of the air, where the gas is most sensitive, and when fired send a volume of flame into the main chamber, insuring instantaneous and complete combustion. This igniter is operated by the cam at the right. The cam in the center opens the exhaust valve.

The engine is capable of high speed, and the uniform combustion and sensitive action of the governor insure a regulation close enough, it is said, to drive dynamos direct without counterbalance. Oil cups are so provided that the engine may be run night and day for weeks without stopping if the work requires it. Provision is made to use manufactured or natural gas in localities where it is more economical to do so.



PROUTY ELECTRO-GASOLINE ENGINE.

A four horse power engine will consume about three pailfuls of water a day, and other sizes a corresponding amount, the water being used at the boiling point and circulating by gravity. Cold water has the same unscientific effect on a perfect gasoline engine, says the manufacturer, that ice would have if applied to a steam engine. The water tank is set at any convenient point on a parallel with the engine cylinder. The gasoline tank is located at any suitable place, only on a parallel with the plunger, except in case of large electric lighting or other plants, when provisions are made to take the gasoline from large submerged tanks.

All engines contain the best materials and are constructed by mechanics of highest skill. They are guaranteed without reservation.

New York Street Railway Association.

The fifteenth annual meeting of the Street Railway Association of the State of New York will be held at the International Hotel, Niagara Falls, on September 14th and 15th. The Edison convention will be held in the same city at the same time. Several papers will be read, but the titles are not announced. An elaborate programme of entertainment has been arranged, and on the night of the 15th there will be a grand ball at the International. The banquet is set down for the preceding evening.

Progressive Telephone Factory.

When in the early part of April of the present year the business of the Missouri Telephone Manufacturing company was purchased by J. D. Perry Lewis and H. A. Turner, it was promised that the new management, backed as it was by increased capital, would push this already thriving institution into an enviable position in the telephone field. Apparently this prophecy has been amply fulfilled, as the company now reports a wonderful increase in business. The Missouri company states that it has installed a number of exchanges as well as supplied the material to reconstruct not a few exchanges that had already been placed by other companies. Believing that the policy of "the very best goods at fair prices" would be a winning one in the long run, the management has spared no pains to improve in every way possible and keep its apparatus thoroughly up to date. Such a policy necessitates the employment of the highest grades of material as well as the most skilled workmanship, and, of course, enables the institution to guarantee that its product is as good as money can buy. Several new styles of instruments not mentioned in the company's catalogue have been recently brought out, and the general improvement throughout its product has necessitated the preparation of a new and complete catalogue, to be out by the first of the year.

A word relative to the management of the Missouri Telephone Manufacturing company will be of interest to many. President Lewis has long been identified with electrical matters, having made electrical engineering a study from his boyhood. He was graduated from the Troy Polytechnic Institute, and is well versed in all branches of electrical science, both practical and theoretical. Mr. Lewis built with his own hands one of the first electrical carriages that was ever made, and he still has this vehicle in use and frequently rides in it through the parks of St. Louis. Mr. Lewis is personally in charge of all the Missouri company's technical matters; in fact, this branch of the business is left exclusively to him.

Mr. Turner, the secretary of the company, was formerly manager of the Union Casualty and Surety company of St. Louis, and his extensive knowledge of financial matters eminently fits him for his present responsible position. Mr. Turner, too, is constantly in attendance at the company's factory, and in addition to his duties as secretary he is always on hand to welcome and extend courtesies to the company's numerous customers that visit St. Louis to investigate before making large investments in telephonic apparatus.

Manager of Sales Henry A. Coit is one of those young men bound to succeed; of pleasant address, keen and progressive in his ideas, he is well calculated to handle the business of a concern operating on modern business lines. Mr. Coit was formerly a broker in crude drugs, and has traveled extensively all over this country in that line of business, and enjoys a large acquaintance. He has also been connected with several large real estate deals in St. Louis.

The company states that business has increased so much during the last six months that it will be obliged to move from the present quarters by the first of the year. The company expects to build for itself, and when located in the new establishment it will be able to show one of the most complete telephone factories in the country.

Personal Characteristics of British Scientists.

A writer in the New York Tribune gives some personal gossip of the leading men at the Toronto meeting of the British Association which is of considerable interest.

Lord Kelvin, he says, held the post of honor at receptions and banquets, and in the groups of distinguished people on the stage at various meetings and lectures of general interest. Although his beard and hair were white, his keen eye, ruddy countenance, happy humor and vigorous intellect made it difficult to believe that he had attained the age of 73 years. When speaking he turned from side to side with great frequency, and, if he stood before a table, he was almost sure to lean over slightly, resting his outstretched finger tips upon it. These remained almost stationary, even though his body swayed about them continuously. He spoke hesitatingly at times, even when much in earnest, evidently seeking with great care for the right phrase or word. In this latter effort he was always successful. There was nothing in his appearance that suggested the fop, but he was more observant of the small conventionalities of dress than most of the elders beside him. Lord Kelvin's wife and a niece, Mrs. McDonald, accompanied him to several of the scientific meetings and all of the garden parties that he attended. Mrs. McDonald, like her husband, is much interested in economic science. Lady Kelvin is a handsome woman, with excellent conversational powers, and attracted much attention. Although Lord Kelvin has engaged in a great variety of researches, and invented several different instruments, the one thing in his career which was chiefly emphasized in all the speeches relating to him was the share he had in making submarine telegraphy a success.

Further on, the Tribune man remarks that Lord Rayleigh had encouraged the local committee in Toronto to expect him there, but he was detained in England by some cares not generally known. So, too, was Mr. Preece, head electrician of the British postal service. Dr. Oliver J. Lodge, another authority in electrical matters, came over, however. He had little to say in the lecture room, but made a handsome end man in a row of dignitaries on the stage. Dr. Lodge is a large man, with a bold forehead, like that of Henry George. But his hair is darker and his figure is more commanding than that of the great expositor of single-tax ideas.

Large Factory Transmission Plant.

From a brief description of the electrical power transmitting and translating plant of the Ramapo Iron Works of Hillburn, N. Y., in the Railroad Gazette, the following data are taken:

The entire plant covers about 12 acres, and the total floor area of the shops is about 100,000 square feet. The products are frogs, switches, stands, crossings, cars, brakeshoes, miscellaneous castings and general track supplies. Being situated on a narrow neck of land between the Erie railroad and the turnpike it was necessary to spread the buildings out along the line of track, which, of course, enables the material to be handled very conveniently. The railyard in which is kept a stock of about 80 different sections, is at the north end, on the west side, and next to this is the saw shop, and immediately following are the planing and erecting shops. In the latter the material is handled by an electric crane of five tons capacity, covering an area of 25 by 140 feet. The buildings on the east side of the track are arranged so that the finished product from one department can be taken directly into another building, where the work progresses without unnecessary interruption.

The steam for the plant is generated by one 60 horse power and one 150 horse power horizontal tubular boiler at a pressure of 80 pounds, and two 150 horse power horizontal tubular boilers at 125 pounds pressure. The power is furnished by two engines. One is a Wetherill Corliss of 170 horse power, operating main shaft through switch and frog planer shops and air compressor, and the other a 150 horse power Westinghouse compound engine operating a Westinghouse continuous current dynamo rated at 500 amperes and 250 volts, or about 168 horse power, running at a speed of 700 revolutions per minute.

The motors are distributed as follows:

Saw Shop.—One 10 horse power Lundell, running three rail saws and a saw grinder.

Switch Planer Shop.—One 10 horse power Lundell, running three drills, a bender and an emery wheel, and a 25 horse power Lundell, running heater fan.

Pattern Shop.—One 7½ horse power Lundell, running circular saw, turning lathe and face plate, and one two horse power Lundell, running jig saw.

Frog Erecting Shop.—One 10 horse power Gibbs, running punch and shear; one 7½ horse power Lundell, running three radial drills, a rail bender and a grindstone; two 10 horse power Westinghouse, running eight emery wheels, and one three horse power Lundell, running rail saw.

Store House.—One 10 horse power Lundell, running shear.

Foundry.—One 35 horse power Lundell, running two blowers for stacks, three cinder mills and a hoist.

Machine Shop.—One 10 horse power Lundell, running five engine lathes, one speed lathe, two crank lathes, shaper, milling machine, three planers and two radial drills; a 7½ horse power Gibbs, running two turret lathes, and a three horse power Lundell, running two pipe-cutting machines.

Blacksmith Shop.—One 10 horse power Lundell, running punch and shear; five horse power Lundell, running emery wheel; one-half horse power Lundell, running small drill; 12¾ horse power Lundell, running blast and part of machine shop; 20 horse power Lundell, running blast; 15 horse power Westinghouse, running heater fan; 15 horse power Westinghouse, running bolt plant, drop hammer and trimmer, and a 15 horse power Westinghouse, running bulldozer.

Car Shops.—One 50 horse power Westinghouse, running four-sided planer; 25 horse power Lundell, running circular saw; 25 horse power Lundell, running cut-off saw and tenoning machine; 15 horse power Lundell, running boring and gaining machine; five horse power Lundell, running radial drill, bolt cutter, small drill and emery wheel; 15 horse power Westinghouse, running mortising machine and band saw, and a 30 horse power Westinghouse, running shaving blower.

The longest electric circuit is 2,200 feet. This main is composed of two lines of 0000 (B. & S. gauge) wire and the voltage is kept at 225 at the dynamo. Switchboards are conveniently located in all the shops, and each is supplied with an automatic cut-out. Current is used during the daytime for lighting the fireproof vault and the engine and boiler rooms. When used thus, four 50 volt lamps are placed in series. When required in large quantities, all suitable forgings are formed on either the bulldozer or drop hammer, the motors on which handle the work without difficulty. Considerable die work of a large character is done on the large punch and shear.

Outside of the electrical features, as given above, the company has made a beginning in the use of compressed air, using it for small rail hoists, a large overhead traveler for transferring material from narrow gauge to full gauge cars, and also on a portable power riveter. Besides this they are building a 60 foot span overhead traveler for the foundry, to be operated by compressed air, and are considering the advisability of using this power in place of steam to work the power hammer in the blacksmith shop. Some chipping has also been done with compressed-air tools, with considerable satisfaction.

Lightning Strikes Brooklyn Trolley Wire.

[From the New York Tribune, August 23d.]

In the thunderstorm which arose just after six o'clock, while the lightning was flashing and the rain was pouring in torrents, a bolt struck the elevated railroad structure of the Brooklyn Elevated Railroad company, which runs through Hudson street, at Willoughby street. The crosstown electric line of the Brooklyn Heights railroad runs down Willoughby street at this point. The wire was melted by the lightning, and a seething, cringing line of fire fell into the street, sending up a shower of sparks. A policeman standing two blocks away, at Myrtle avenue and Hudson street, thinking there was a fire, sent in an alarm from box No. 31. Engine company No. 10, whose house is in Carlton avenue, near Myrtle avenue, responded. The wire had ceased to burn when the company dashed into Willoughby street from Hudson street. Quicker than a flash the engine had run on to the wire, and in a minute sparks were flying in all directions from the apparatus. The horses reared and plunged, and the firemen, jumping from their seats, went to hold them. As the men grasped the metal of the engine they received severe shocks, and some were thrown to the ground. The hosecart, which was coming up rapidly behind, turned violently to the right, narrowly avoiding a collision, and also became tangled up in the wire. John Mullaly, the driver, was thrown to the ground and received such a severe shock that he had to be removed to his home, No. 72 Lafayette avenue, where he will be laid up for several weeks.

One of the horses of the engine, Dick, in his struggles, got the wire wrapped around his neck and body, and slowly burned to death, his cries frightening many persons.

The firemen soon recovered, and cut the wire. They then went to the rescue of the other horse, which was not killed, but had to be taken to the department hospital. A telephone message was sent for another pair of horses, and the engine company returned to its house.

Lightning Rods on Flagpoles.

[From the New York Sun.]

Fewer lightning rods proportionately are used in a large city like New York than in smaller cities and towns and in the country; but if they were sought for in this city they would be found in considerable numbers. They are less conspicuous in a compactly built city, and they may be quite out of sight. They are likely to be found here on churches, though they may be so placed as not to be seen by the casual observer from the usual point of observation, the street in front. They are placed on various other buildings, and sometimes here on flagpoles. On flagpoles the lightning conductor, a copper cable, is wired to the steel rod that supports the vane, if the pole is surmounted by a vane, and carried down the rear side of the pole, to which it is secured, and over the roof and down to the ground at the rear of the building. If there is no vane on the pole, the lightning conductor starts from the ball at the top. The cable is secured to the rear of the pole so as not to mar the symmetry of the pole's appearance, and because the cable runs off to the ground on that side.

Boston Subway In Use.

Early on the morning of September 1st the first regular trolley car was run through the complete portion of the new Boston subway. There was no formal opening. The first car was switched in, and went down the incline in the most commonplace, ordinary manner. The trip from the portal in the public garden to Park Shelf was made in just four minutes. The same trip on the surface cars would occupy 10 minutes, and in the rush hours 15 or 20. The great tunnel was in splendid condition. It was brilliantly lighted and perfectly ventilated. There was no hitch of any kind in the arrangements. The cars ran finely over the perfectly ballasted tracks, and the new employes handled the great crowd of curiosity seekers, who ceaselessly rode back and forth all day, with perfect expedition.

After a legal battle at Aurora, Ill., lasting four weeks, the Aurora and Geneva Street Railway company succeeded on August 27th in condemning private property for its own use. The company has been seeking right-of-way from Batavia and Geneva through some of the beautiful suburban country seats owned by Chicago people, much to their displeasure. The property owners made a hard fight, first to prevent the construction of the line and then to collect large damages. The jury allowed the property owners $4,533, one-tenth of what they asked.

CORRESPONDENCE.

New York Notes.

New York, August 31.—One of the many "hearings" in the matter of installing trolley conduit service in this city was given on Friday by General Collis, commissioner of public works. President Elias and his counsel, William H. Page, Jr., and an engineer of the Third Avenue system, of which the Forty-second street railroad is a part, were present. The Metropolitan company was unrepresented, Elihu Root and W. C. Whitney having already appeared and protested on behalf of the company against the granting of the application on the ground that the cars of the Forty-second street line would run over the Metropolitan company's tracks at six different points, and would interfere with the company's traffic if the change of motive power were made. General Collis' proposition that both companies use the same tracks on Amsterdam avenue, from Seventy-first street to One Hundred and Twenty-fifth street, was also opposed by Mr. Whitney and Mr. Root on the same ground. When the hearing opened, Mr. Page, on behalf of the Third avenue company, said that the company was willing to accept General Collis' proposition that the companies should use the same tracks in Amsterdam avenue if the Metropolitan company was bound by an agreement from which it could not recede. A letter from Mr. Root, however, said that his company could not even consider the proposition. General Collis said that he would compel the two companies to use the same tracks if he had the power, and he would ask the opinion of the corporation counsel as to his power to refuse both permits if the companies declined to use the same tracks. In the meantime he would grant the Metropolitan company's application for permission to change its motive power in that avenue. Mr. Page protested vigorously against this decision, but his argument did not affect General Collis' determination. The hearing was adjourned to obtain the opinion from the corporation counsel.

The sessions of the Supreme Court's special commission, appointed to report on the feasibility of the tunnel railway scheme proposed by the Rapid Transit Commission, will be resumed one week from to-day.

The contract for equipping the vaults of the United States Treasury with electric burglar alarms has been awarded to the Home Electric Protective company of this city.

Staten Island is a hot-bed of electric railway contention. The latest outbreak is caused by the alleged seizure of the sidewalk on one side of Richmond avenue, from the boundary line of Port Richmond to Bull's Head, a distance of two miles, by the Staten Island Electric Railroad company. Many residents of Graniteville claim that the company has gone further —that it has laid its tracks and erected its trolley poles on private land, and that its agents have laughed at the owners when they dared to protest. A highway commissioner is said to have exceeded his powers, and it is said that damage suits will be instituted.

It is certainly very unfortunate that the city of Paterson, N. J., should be compelled to suffer the great inconvenience of a second breakdown in the station of the Edison Electric Illuminating company within two weeks of the first. These accidents are the more mortifying to electrical men, as the new Paterson plant was supposed to be one of the crack Edison stations of the country. Evidently, however, there were radical defects of construction, however theoretically efficient the installation might be. The second accident occurred on Sunday evening, and was due to the breaking down of a pump. The whole plant was shut down for several hours, and in consequence all the electric cars were stalled and practically every electric lamp in the city was dark. In churches lighted by electricity the congregations were dismissed. Thousands of people in the city and suburbs were stranded miles from home by the stoppage of the trolley cars, and hackmen and cabmen did a business only limtied by the capacity of their vehicles. The whole police force was sent out on patrol duty as soon as the serious nature of the accident was apprehended. The people again vividly realized their dependence as a community on this one electrical plant; and it is to be hoped that they will continue to exercise forbearance and patience.

The poor rapid transit scheme has been dealt another blow. It is the park commissioners who object to it now. They say they can't approve of the tunnel plans as at present in evidence, because they will damage Battery Park. The engineer of the Park Department advises that the chief engineer of the Rapid Transit Commission be requested to make further surveys, with a view of improving, if possible, the route of the westerly side of the loop. The park commissioners are sorry they can't approve the plans, but say they must protect the parks. This opposition is believed to entail a further delay of four months.

M. S.

From Old Virginia.

Richmond, August 30.—A new company, to be known as the Albemarle Telephone company, was organized on the 9th at Charlottesville. The company proposes to have its lines in operation at an early day.

It is understood that J. E. Willard of Fairfax has made a proposition to the citizens living between Falls Church and Vienna to build the electric road from Vienna to Fairfax Courthouse if they will build it from Falls Church to Vienna.

A new telephone line passing from Washington, D. C., to Norfolk, Va., has been built through lower Prince William. The line crosses the Southern railway at Sideburn, Fairfax county, passes through Dumfries, Minnieville and through Fredericksburg. It is one of the most substantial lines put up in this section of the state.

The project for utilizing the immense water power at Richmond for the production of electricity is assuming definite shape. The indications of returning prosperity lead the General Electric company and other capitalists behind this enterprise to feel confident that there will be little trouble in obtaining the money needed to carry it out. It is believed that when established this enterprise will do more for the material development of Richmond than all other enterprises that have been attempted for half a century. There is more than 100,000 of undeveloped horse power in the James River at this point.

The affairs of the Home Telephone company took an unexpected turn in Baltimore when Judge Dennis of the Supreme Court of Maryland, ignoring the action of the West Virginia court, appointed Walter B. Brooks, Jr., and John C. Distler, Jr., receivers, and gave them immediate possession of the property. He also enjoined James Russel, the receiver appointed by the West Virginia court, from interfering with the new receivers. The receivers were appointed for the Home Telephone company, which is the West Virginia corporation, and for the Home Telegraph and Telephone company, which was incorporated in Baltimore. The receivers gave bond for $20,000 each, with an additional injunction bond of $5,000. They are now in possession. The plaintiffs in the receivership proceedings are A. Hoen & Co., who, it is understood, are in sympathy with the anti-Atkinson forces in the directory. The suit is brought on an unpaid judgment of $175 and costs.

At a late meeting of the Town Council at Hampton the question whether the Bell Telephone company should be admitted to Hampton was argued and finally decided in the negative. The vote of the councilmen was a tie, and Mayor J. Barrow Thorpe gave the deciding vote against the Bell company, and thus the question was finally settled.

The people who are pushing the plan to build a 40 mile electric railway between Morgantown and Blowing Rock say they are now sure of success.

There is going to be a lively fight at Danville pretty soon over the proposition to put the street cars over the bridge into the Fourth Ward. Petitions for and against the movement are already in the field.

The Sparta telephone line is nearing completion.

Superintendent George R. McDonell of the Portsmouth Electric Street Railway company has tendered his resignation. He has been a most efficient officer, and his departure is much regretted. It is almost certain that his successor will be a northern man.

At an adjourned meeting of the Charlottesville City Council, on the 19th, a charter was granted to the Albemarle and Charlottesville Telegraph company.

The Portsmouth Light and Water company has filed a deed of trust to the Farmers' Loan and Trust company, trustee, to secure consolidated first-mortgage bonds. The total issued is $500,000.

The Seaboard Air Line, whose officers are always on the lookout for the safety of passengers, will in a short time put electric headlights on all its locomotives. A trial light was put on the other night, and it was a decided success. It lights the track, at least for a long distance, as light as day.

Y. P.

New England News.

Boston, August 30.—In the installation of the new storage battery to supply the electric lamps for the lighting of the new union station in New Britain, Conn., the management of the New York, New Haven & Hartford Railroad company has again demonstrated its progressiveness. The officials originally intended to light the stations in Hartford and New Britain with current from the third rail, but the use of the storage battery was decided upon for three reasons: First, as the third-rail cars are in operation only until 11:30 p. m., the machinery at the power house would have to be kept running for lighting only after that time; second, in the event of an accident to a third-rail car, or in the case of the circuit being broken because of a wire across the tracks, the lights would be extinguished; third, the storage battery was considered cheaper, because it could be charged without extra power during the time that the cars stand at the New Britain and Hartford stations. The battery now ready to be placed in the passenger station at New Britain will be of sufficient capacity to operate 500 lamps for 24 hours. The battery in Hartford will be of the same size. The third rail will be tapped at both stations for the battery supply wires. The present cost of lighting the union station property in Hartford is said to be about $500 a month, and the estimated cost of operating the storage system will be about one-fifth of that amount.

The network of wires which has been stretched above the buildings in Boston has fast disappeared under the diligent work of the Wire Department of the city. During the first half of 1897 more than 60,000 feet of subway has been built. A synopsis of the work done by the Wire Department during the last six months, issued from the office of the department, states that the various companies using underground wires have jointly laid 60,543 feet of subway, and 273,718 feet of duct, and that 261,311 feet of cable has been drawn in. There was also 344 service connections and 206 manholes built. In addition to this, the Edison Electric Illuminating company laid 37,500 feet of solid tubing and located 35 distributing boxes. Plans have been filed by the West End Street Railway company for 157,000 feet of duct; Edison Electric Illuminating company, 112,000 feet of duct; Boston Electric Light company, 95,000 feet of duct; New England Telephone and Telegraph company, 47,000 feet of duct. The Edison company has plans filed for an additional 100,000 feet of Edison solid tubing to be laid in the coming six months. The New England Telephone and Telegraph company has extended its underground system to an extent comprising 99,603 feet of duct. There has been removed by the department 697,950 feet of wire, of which 25,650 feet has been retained; the remainder has been deposited on the dumps. The estimated amount of wire in the 1897 underground district is 2,765,590 feet, about one-half of which is high-tension wire. The department has investigated all fires and accidents due, or supposed to be due, to electricity, and found that 40 fires were due to electrical causes.

A syndicate composed of R. W. Brown, E. P. Page, J. P. Clark and A. H. Weston has bought the Norridgewock and Skowhegan (Me.) electric railroad from the bondholders, paying $15,000 therefor. The road cost, when constructed four years ago, $55,000. It is proposed by the new syndicate to improve the line and to build a hotel in Norridgewock and a pleasure pavilion at the Pines, about half way between the two villages. It is expected that the improvements to be made will cost about $40,000.

Edwin G. Crocker of Bridgeport, Conn., has invented a new surface-contact electric railway, and the demonstrations so far given are said to have been highly successful. The magnet boxes and insulated wires from which the power is derived are covered with cement and located below the level of the roadway. Among the interested spectators at the first private trial of the invention was Daniel S. Lamont, former secretary of war and now second vice-president of the Northern Pacific railway.

An important business transaction was consummated in Lewiston on August 25th, when the majority of the stock of the Lewiston and Auburn electric railroad was sold to a syndicate composed of Amos F. Gerald of Fairfield, the Hon. I. C. Libbey of Waterville and Galen C. Moses and the Hon. Fritz H. Twitchell of Bath. Several weeks ago the syndicate bought $152,000 of second-mortgage bonds which was held in Portland, and later $25,000 of the second-mortgage bonds which was held by the Framingham (Mass.) bank. On the 25th the syndicate concluded its deal for $34,500 of the second-mortgage bonds held by the Manufacturers' Bank, $15,000 of which was held by the First National Bank and $7,500 which was held by the Androscoggin Savings Bank, both of Portland. The total amount of bonds which was issued by the company was $350,000, and of the amount $85,000 was impounded. The syndicate now has the control of $235,000 of the bonds, and will assume control of and reorganize the road. In another year the syndicate will carry out its plan of issuing $750,000 worth of bonds and of building a trunk line from Lewiston to Brunswick, and from that place to Bath. It may also build a line from Lewiston to Turner.

C. S. G.

Northwestern Notations.

Minneapolis, August 31.—The city engineer of Duluth, Minn., was instructed to prepare plans for an electric light plant.

Eagle River, Wis., has voted to contract with F. J. Thrun to furnish electric lighting, he to operate the waterworks in connection.

H. C. Sterling will put in an electric light plant at Huron, S. D.

O. D. Armstrong has given up the project to put an electric light plant in at Kasson, Minn.

Eastern capital is interested in a project at Butte, Mont., to secure water power from Big Hole river and generate electricity. The estimated cost is $500,000 to $1,000,000.

The Mankato, Minn., City Council has received two bids for furnishing electric lighting for five years—one from the present company and one from a new company to be known as the Independent Electric company. The prices of the two companies are practically the same, and the council is understood to be a tie on the matter.

The South Kootenay Water Power company of Nelson, B. C., has arranged to put in a plant to generate electricity.

The Mason City and Clear Lake Traction company has completed 17 miles of its road in the time promised, and has it in operation.

After vainly attempting to secure the operation of the street railway system in Stillwater, Minn., the council has brought suit to compel the owners to take up the tracks and for the annulment of their franchise.

The negotiations between the Oshkosh Street Railway company and the Citizens' Traction com-

pany for the purchase of the former's system by the latter are all off, and it is understood that the Street Railway company will change its lines to electric power at once. At the same time the Citizens' company will build a line to the south side of the city.

An electric light plant will be put in at Argyle, Minn.

The sale of the Belle City street railway in Racine, Wis., was confirmed, and a new company, composed of old bondholders, now has the system.

R. L. Frazee contemplates putting in an electric lighting plant at Pelican Rapids, Minn.

The council of Kaukauna, Wis., voted to replace the incandescent lights of the city streets by arc lamps.

At Traer, Ia., reduction in the price of electric lighting is offered if 50 additional patrons are secured.

C. N. Parker offers to extend the Brainerd, Minn., street railway and operate it for a year longer if a bonus of $2,500 is raised.

Changes and improvements in the fire-alarm system of St. Paul are proposed, at a cost of $6,000.

Forée Bain of Chicago has sued Hennepin county for $200, which he says is still due him for services as electrical expert in looking over and reporting on the condition of the electric equipment of the Minneapolis courthouse. The county commissioners dispute the bill.

The Tacoma Railway company has offered to furnish the city power for operating its lighting plant at 1½ cents per kilowatt-hour, provided the city pays $7,500 toward changes in the building and machinery.

H. H. Hagensick and others are applicants for an electric light franchise at Elkader, Ia.

A trolley line from Charles City, Ia., to Rockford, Ia., is projected.

Work has been begun on the electric light plant at Park Rapids, Minn.

The Commonwealth Lumber company of Frazee, Minn., has ordered an electric light plant for its lumber mill.

The Consolidated Gas company of Davenport, Ia., has received a new 1,000 light dynamo.

The Apple River Power company of New Richmond, Wis., has let the contract to build a dam to generate electric power.

E. W. B. Snyder and others will put in an electric light plant at Sanborn, Ia.

A committee from Carson, Ia., is examining electric light plants at other points and will report on the best system for Carson.

The contract for furnishing and installing an electric light system at the insane hospital at Rochester, Minn., was let to the General Eectric company for $17,200.

The electric light plant at Augusta, Wis., has been completed and tested.

The electric power station at Eldon, Ia., is about completed.

The Board of Equalization in St. Paul has finally placed the valuation of the St. Paul City Railway company's system for assessment purposes at $2,000,000. It was first proposed to make it $2,500,000, but it was finally reduced.

The village of Wadena, Minn., has purchased the electric light plant from Northfoss & Sons for $7,666.

The new electric light plant at New Prague, Minn., is completed and in operation.

The council of Wells, Minn., is considering increasing the capacity of the electric light plant.

George E. Brettell of Lead, S. D., proposes to utilize the water power of Spearfish Creek to develop electric power. He expects to secure two plants of 1,200 horse power each, but will begin with a small one of 300 horse power.

It is reported that C. N. and F. Parker will take up and remove the electric car line from Brainerd, Minn., to Fargo, N. D.

Capt. J. S. Bradley and others of Charles City, Ia., have been corresponding with various persons in regard to a trolley line to Rockford, Ia., from Charles City, Ia.

The Board of Equalization of St. Paul has reduced the valuation of the street railway company's system from $2,000,000 to $1,650,000, the reduction being on the item of tracks and trackage.

P. J. Petrie of Long Prairie, Minn., contemplates establishing a flour mill with an electric light plant in connection at New Paynesville, Minn.

Samuel P. Howard has sued the Butte Consolidated Street Railway company of Butte, Mont., and the Butte, Anaconda & Pacific Railway company for $5,000 damages. Howard was a brakeman on the railroad, and when on top of a furniture car, while in the performance of his duties, was struck by the trolley wire of the street railway company, which the latter had maintained at an insufficient height, was thrown down and the ear drum punctured, destroying his hearing and preventing him from pursuing his vocation.

J. C. Gauvin, for several years an electrician employed on the Brainerd electric railway of Brainerd, Minn., has gone to Fargo, N. D., where he will put in a lot of new machinery and will later go to the Pacific coast.

Henderson, Minn., voted to establish electric lights.

It is currently reported that the Mason City and Clear Lake Traction company will extend its trolley system from Clear Lake, Ia., to Lake Mills, Ia.

C. W. McElyea of Cedar Falls, Ia., has ordered two of the Patton storage electric motors for his street car line, on trial.

The Huron Electric Light and Power company has sold its plant to Harry S. Sterling, who will at once put in an improved system. He has leased the Risdon artesian well for power.

The Electric Light and Power company of Chatfield, Minn., is rapidly putting in its new plant.

The Street Railway company of Marinette, Wis., contemplates extending its lines to make a complete loop system or double tracking the present line next season. C.

PERSONAL.

Louis A. Ferguson, general superintendent of the Chicago Edison company, has entirely recovered from his recent illness and is again at his post.

Seth C. Adams has resigned his position as secretary and treasurer of the Bossert Electric Construction company of Utica, N. Y. Frank Schofield of New York succeeds him.

Carl K. MacFadden, formerly well known in Chicago as an electrician and electrical writer, was in town early in the week. Mr. MacFadden now makes his home in Geneva, Ind., in the oil belt, as he is interested in the production of crude petroleum.

Michael J. Burke of Chicago, who has been appointed United States consul at St. Thomas and Fort Stanley, Ont., was president of the Telegraphers' McKinley club and secretary of the Railroad Men's McKinley club during the recent campaign. The appointment was considered as a recognition of the telegraphic fraternity. Mr. Burke was given a complimentary dinner at the Great Northern Hotel by his associates before his departure for Canada.

John Knight, general manager of the Oswego Electric Light and Power company, so well known for his long connection with the manufacture of arc lamps, was a visitor in New York last week. He reports that the general condition of business in the electrical field in the central portion of New York state is better than it has been for several years. Quite a number of large extensions for street railway and electric light companies are under consideration.

In a sketch of the late Hayward Augustus Harvey, the inventor of the famous Harveyized armor plate, the Scientific American gives some interesting facts about his father, Gen. Thomas W. Harvey, who was a skillful mechanic, an untiring experimenter in the metallurgy of iron and steel and an inventor of the gimlet-pointed screw and other mechanisms now in general use. It is said that in Poughkeepsie in 1842 he ran all the machinery in his machine shop by a magneto-electric engine. As early as 1841 he remarked to the late Dr. Hazeltine, at that time an inmate of his family: "If you live to the ordinary age of man, you will see electricity the great motor power of the world."

Edward G. Acheson, president of the Carborundum company of Niagara Falls, was held up and robbed on the night of Friday, August 27th, within a few doors of his home in Buffalo. Mr. Acheson had left his house, No. 41 Fargo avenue, to go to the railroad station, intending to take a train for Pittsburg. It was 11 p. m., and Mr. Acheson's cry of "Murder" startled the neighborhood. He was picked up unconscious and carried to his home, where he revived and told how three young men had attacked him. Two severe scalp wounds told of their ugly work. Mr. Acheson was relieved of his gold watch, a memorandum book and some private papers, but the book and papers were dropped by the thieves. The police believe that he was struck by brass knuckles. What money Mr. Acheson carried was in an inside pocket, and this the thieves did not get. While Mr. Acheson's injuries are severe, his full recovery is expected.

ELECTRIC LIGHTING.

The numerous gas lamps on Michigan avenue, Chicago, between Fourteenth and Thirty-ninth streets, have been replaced by arc lights. The increased volume of light and the change from yellow to white light are noticeable.

In addition to its other troubles the arc lighting plant in Garfield Park, Chicago, is now decided to be too small. The West Park Board has decided to expend about $60,000 in new engines, boilers and dynamos, and in an extension to the power house. Bids will soon be asked.

It is said that Hiram Maxim, the American inventor who lives in England and has given his name to the Maxim rapid-fire gun, has invented a new filament for incandescent lamps. According to the newspaper account, the new filament is made of a mineral instead of a vegetable substance, and, compared with the ordinary filament, it lasts twice as long with the consumption of half the energy for an equal light. However, the further claim of an efficiency of 2.8 watts per candle does not bear this out. It is claimed that the new filaments are very cheap and that a thousand of them can be made for a dollar.

ELECTRIC RAILWAYS.

Plans are on foot for the building of a big street railway system in Cleveland in opposition to the Consolidated lines, according to a dispatch from that city. Most of the capital will be furnished by New York investors. Mayor R. E. McKisson is said to be interested in the project.

The Pensacola (Fla.) Electric and Terminal Railroad company has applied for a charter. The capital is to be $200,000, and the officers are to be as follows: W. H. Northrop, president; A. C. Blount, Jr., vice-president, and D. W. Thom, secretary and treasurer. The length of the railroad proposed is 11 miles. Baltimore men are interested.

There is a newspaper rumor of the creation of an electric railway system along the shore of Lake Michigan, from Chicago to Green Bay, with branches, by building new lines and absorbing existing ones. Warner Miller, the wealthy ex-senator from New York state, is said to be the man on whose action depends the execution of the project.

The Electrical World, which has an office in Chicago, comments sagely on the advertised sale of the steam locomotives of the Lake Street Elevated Railroad company, which has been using electrically transmitted power for about a year and a half. It explains that the railway system of the company mentioned "is ordinarily known as the Alley elevated railway" and that it is to be equipped with the Sprague system.

The electric railways in Dresden are equipped with about 200 of the Siemens & Halske electric brakes, and it is said that they have given excellent results during the last 12 months. These brakes act upon the car axle, which is not driven by the electric motor. They are fixed both upon the motor car and upon each of the trailers, and act simultaneously. It is claimed that these brakes act in about one-third of the time of the hand brakes. Trials with both show that the electric brake stopped a car going at the rate of 15 miles per hour within 14 yards, while a car with a hand brake going at 12 miles per hour traveled 35 yards after the brake was applied. The same electric brakes are used for the line Behrenstrasse-Treptow at Berlin. In this case the brake acts upon the motor direct, and there is no brake upon the trailing carriages. When going at the usual speed these cars are stopped within eight yards.

TELEPHONE.

George W. Schening of Memphis, Tenn., has lately purchased the Greenwood, Miss., exchange. He also owns the exchange at Corinth, in the same state, and both are reported to be successful.

The following statistics, which come from reliable authority, give some idea of the spread of the independent telephone movement: The independent telephone exchange at Ft. Wayne, Ind., has 2,405 paid subscribers, and the Bell at same place 1,600; the independent telephone exchange at Detroit, Mich., has 4,006 paid subscribers, while the Bell claims only 2,190; at Grand Rapids, Mich., the independent company has 2,350 paid subscribers, against the Bell's 900, and at Lafayette, Ind., the independent has 670, where the Bell can show but 41.

Judge Nathan Goff of the United States Circuit Court at Richmond, Va., has sustained the Bell Telephone company in its fight with the City Council. The council refused to renew the company's charter unless certain conditions were granted, which the company refused to submit to. An injunction was secured restraining the city from interfering with its lines or works till the case could be decided by Judge Goff. One claim of the company was that the streets it occupied were postal roads and part of the mail system. The court upholds the company's contentions.

MISCELLANEOUS.

The commissioner of public works of Chicago has taken steps to enforce the provisions of the ordinance passed two years ago requiring steam, cable, electric and horse railway companies to furnish light at street intersections on their lines.

The Portsmouth Street Railroad and Light company, Portsmouth, O., is receiving prices for one new railway generator, one new 2,000 volt alternating incandescent light machine and two 50 light arc machines. It expects to contract for this apparatus not later than September 15th.

A press dispatch states that Robert S. Straine, president and director of the United Telegram company in Boston, was arrested on August 30th on a charge of embezzling $73,500. The arrest is the result of the discoveries of Marsden J. Perry, receiver of the company, who reports that there is only $76.14 in the treasury, instead of the $73,444.21 that ought to have been there.

Competition is a good thing if not carried too far. Recently it involved two German engineers in litigation, and one of them was severely punished for criminal libel. The trouble grew out of a contract for a municipal plant at Munich. Oscar von Miller commented upon a competitor, Karl Cörper, and the latter accused von Miller of acting in the double character of consulting engineer and contractor, and made insinuations against his professional and his moral character. The evidences of the witnesses in court completely failed to substantiate any of these

charges, and von Miller was shown to be an expert of the highest standing and professional character. The sentence on the defendant was 14 days imprisonment, since the judge considered that a fine would not be a sufficient punishment to a man in the defendant's position.

TECHNICAL SCHOOLS.

The Society for the Promotion of Engineering Education, at the closing session of its Toronto meeting, elected the following-named officers: President, Prof. J. B. Johnson, Washington University; vice-presidents, Dr. T. C. Mendenhall, Worcester Polytechnic Institute, and Dr. H. W. Tyler, Massachusetts Institute of Technology; treasurer, Prof. J. J. Flather, Purdue University; secretary, Prof. A. Kingsbury, New Hampshire College.

ELECTRICAL SECURITIES.

On September 1st the Chicago City Railway company declared a quarterly dividend of three per cent., payable September 30th.

During the first six months of the present year the Albany Street Railroad company's gross earnings were $269,959, an increase of $5,628 over the corresponding period a year ago, while the net earnings for the same period showed a gain of $14,092.

The Buffalo Street Railway company found the first half of the present year unusually trying. Its receipts show a falling off of $42,255, as compared with last year's, but the net earnings were better by comparison, although there was a decrease there, too, of $20,355.

In Detroit the Citizens' Railway showed an increase of $30,578 in its gross earnings from January 1st to June 30th, and $59,717 in its net earnings, as compared with the same period a year ago. The Detroit Electric Railway company, on the other hand, records a decrease of $15,882 in its receipts and $518 in its net earnings during the first six months of the present year, compared with 1896. The receipts of the Citizens' Railway amounted to $617,137 and the Electric Railway $234,364.

Chicago Lake Street "L" sold up to 18 this week. Favorable action by the Cicero Town Board on Mr. Yerkes' application for certain rights for his suburban electric road, which will enable it to approach the Lake Street "L" terminal in the most desirable manner, was anticipated. The trustees of the town would also give the Lake Street "L" permission to build an extension farther west, it was believed. The favorable conditions under which the Lake Street "L" company goes into the loop agreement have also improved the feeling toward the stock. On the other hand, Metropolitan "L" shows signs of weakness.

Central Union Telephone stock continues to attract considerable attention among Chicago investors. The company has been steadily gaining business, and with the sum realized from the bond sale the floating debt has been taken up and valuable improvements made in the plants of the principal cities and towns in Illinois, Indiana and Ohio in which the company operates. The earnings at the present time, it is said, justify a resumption of dividends, and this may account for the interest already manifested, although the policy of the directors is to acquire a good surplus and postpone the payment of a dividend until next January.

The Edison Illuminating company of St. Louis has defaulted in the payment of the interest on a $4,000,000 mortgage on its property, and the plant is to be sold under foreclosure proceedings on September 11th. The holders of 3,977 shares have signed an agreement for the reorganization of the company on a plan favored by the Street Railroad and Illuminating Properties company of Boston, the largest stockholder. James Gamble, who owns 57 shares of stock, is opposed to the reorganization, and applied to Justice Dickey in the Supreme Court in Brooklyn August 24th for an order to stay the sale under foreclosure. He alleged that the directors had appropriated $1,365,000 of the funds for fictitious improvements, part of which money ought to have been used to pay the interest on the mortgage. Justice Dickey denied the application on the ground that the Knickerbocker Trust company, the trustee, had a right to sell the property under foreclosure, and that as the reorganization plan was perfected, interference with it would be disastrous and the injury incalculable. There was no proof that the plaintiff had been tricked or defrauded.

Occasionally the "financial authorities" of the daily papers lose their reckonings. The Chicago Tribune, for instance, printed the following announcement last Sunday: "It is probable that one of the first important ordinances which will come up before the City Council when the vacation period is over will be to grant the City Railway permission to convert its cable lines to electrical power by the stringing of overhead wires in the downtown district. The cost of making the conversion is estimated at about $1,250,000, and on the basis of the present wage scale a saving through electrical operation considerably in excess of the annual interest on that sum of money is figured. It is expected that the City Railway company directors will soon hold a meeting to finally determine on the change. City Railway stock at present is selling at 243. It is rumored that earnings during the last month were greater than during any month since the World's Fair year. The whole earnings for that year were at the rate of 26 per cent. on capital. It appears incredulous that any present condition could have brought earnings up to anywhere near that rate." The City Railway people would be glad to corroborate this statement, but unfortunately the facts do not warrant it.

TRADE NEWS.

At about 11 a. m. on Tuesday, August 24th, the building at 904 and 906 Nassau street, Philadelphia, occupied by Elmer G. Willyoung & Co. as a branch shop, and in which were also the drawing and photograpic rooms, experimental laboratory and glass shop, took fire and was practically destroyed. The loss was about $3,000, offset by insurance to the amount of $2,500. The plant was used principally for the manufacture of induction coils and X-ray apparatus. New quarters were secured at once, and within 24 hours work had been resumed. The delay in orders due to the fire will not be longer than three or four days.

On August 25th Judge Putnam of the United States Circuit Court for the Eastern District of Massachusetts rendered a decision in favor of the complainant, with an order for an injunction and accounting, in the suit of the Consolidated Car Heating company of Albany, N. Y., against the American Electric Heating corporation and the West End Street Railway company of Boston, Mass. This is the suit for the infringement of the patent to James F. McElroy, covering the Consolidated Car Heating company's spiral coil construction of electric heaters, which is now used, it is said, in the majority of street cars operating electric heaters in this country. It is considered a most important victory.

Walter C. McKinlock, 1108 Fort Dearborn building, Chicago, although but recently started in business for himself, has closed some good contracts for rubber-covered wire and incandescent lamps. Mr. McKinlock is handling the Merritt Electric company's products. This company is a renewer of incandescent lamps, and is said to be the original refiller of lamps. It can refill any lamp made, it is claimed, in a manner that makes it impossible to distinguish it from a new lamp. A new lamp is practically made from a burnt-out one, and as a new filament and new vacuum are the only essential things, there is no good reason why every lamp user should not renew his lamps. The factory that Mr. McKinlock represents has a capacity of 25,000 lamps per day. On any order the lamps can be refilled and returned within three days.

On August 20th in the United States Circuit Court at Boston, Mass., in the case of the Hart & Hegeman Manufacturing company against the Anchor Electric company of Boston, Judge Putnam ordered the respondents to file a draft decree dismissing the bill with costs. This action was for the infringement of a patent for snap switches. In his opinion, Judge Putnam holds that the Anchor Electric company's manufacture is a device clearly described and explicitly covered by a patent issued to Norman Marshall, vice-president of the Anchor Electric company. Judge Putnam further finds that the switches manufactured by the Anchor Electric company in nowise infringe the Hart patent, and in conclusion says: "If the complainant has any remedy, it is not in the courts, but in convincing the purchasing public that the device of the respondents is less simple, economical and compact than its own." C. F. Mitchell of New York appeared for the complainant and E. P. Payson of Boston for the defendant.

Owing to the large increase in the business of the Singer Manufacturing company of New York of late, it was moved to consider the appointment of an assistant general manager. After looking about for the right man for some little time, it offered the position to Mr. E. H. Bennett, Jr., general manager of the Diehl Manufacturing company of Elizabethport, N. J. The selection of Mr. Bennett to fill this high position is a well merited compliment to his previous efforts, as shown in the building up of the Diehl Manufacturing company from a small concern to its present large proportions. It is a real pleasure to learn that he will not entirely sever his connection with the electrical trade, in which he is so favorably known, but will keep a general oversight of the business of the Diehl Manufacturing company. When it is understood that the Singer company has nearly 60,000 people in its employment in various factories in this country and abroad, and that the greater part of the detail of running the affairs of the concern will rest to a large extent with Mr. Bennett, the great responsibility which he has accepted in taking this position can be appreciated; but, taking his past record as a criterion, there is no doubt as to the success he will achieve in his new field of operations. He certainly has the best wishes of a host of friends in the electrical business.

The largest and most imposing catalogue of electrical supplies issued within the last two years is undoubtedly the general catalogue of the Electric Appliance company, Chicago, which has just made its appearance. This is a cloth-bound volume of 567 pages, each 6½ by 10 inches. It lists, with prices, trade numbers, code words for ordering, dimensions and other information, electric light, power and railway supplies, telephone and telegraph goods, electrical house goods and other apparatus that may reasonably be expected in a completely equipped electrical supply house. Nearly every piece of apparatus described is illustrated by one or more cuts, and the general arrangement and printing are satisfactory. The book seems to be a very complete compendium of electrical supplies. The publishers are entitled to congratulations upon it, and they seem to have made good the promise of a prefatory note: "We have made it a special point to list only such articles as are reliable and standard, and not cumber the catalogue with specialties and novelties whose only merit is that they are different from something else. We think that a careful examination of these pages will easily convince an experienced investigator that it contains more solid information than any other electrical catalogue of anywhere near the same size, and that in it can be found any material that properly comes under the head of electrical supplies."

BUSINESS.

September blotters issued by the Warren Electric and Specialty company of Warren, Ohio, recall the fact that this company is fighting the incandescent lamp pool as vigorously as ever.

The Blue Hill Electric company of Canton, Mass., has added to its plant a horizontal tubular boiler, built by the Stewart Boiler Works of Worcester, Mass., having dimensions of six by 17½ feet.

The Mason Electric Equipment company of 1202 Fisher building, Chicago, deals in electric railway supplies exclusively, and furnishes everything for the complete equipment and maintenance of electric roads. It directs special attention to its line hangers with patent locking device.

Edward L. Nash, manager of the Philadelphia office of the Jandus Electric company, was a visitor in New York last week. He reports a brisk demand for the Jandus arc lamp, far in excess of that of July. The new "Midnight Sun" catalogue of this company is highly appreciated.

Says the Evening Post of Lincoln, Neb.: "Frank Thompson, representing the Triumph Electric company, to-day closed a contract with H. Herpolsheimer & Co. for the putting in of a $2,000 electric plant at the big department store. Mr. Thompson has made several other large contracts in Lincoln."

J. M. Hill, the western agent of the Bryan-Marsh company, has returned to Chicago from a six weeks' business trip in the Northwest and middle West. He says that he found everywhere indications of better business conditions. He booked a number of orders, and is highly gratified at the success of his journey.

The Gisholt Machine company of Madison, Wis., makes lathes and tool-grinding machines. It has just issued a fine catalogue, very handsomely illustrated, which shows a line of high-class machine tools. Pictures of a variety of pieces finished on Gisholt lathes are given; and, taken altogether, this catalogue shows a line of machinery which is very creditable to the company producing it.

The Ball Engine company, Erie, Pa., says: "The J. S. Menken company, Memphis, Tenn., in a letter to us ordering a crank-pin box for a 60 horse power engine, says that this is the first repair part ordered since the installation of the engine 10 years ago. This substantiates our claim, which we can verify by other instances, that a well built high-speed engine has as long a life, with greater freedom from repairs, than a slow-speed engine."

The Commercial Electrical Supply company of St. Louis is beginning its usual large fall business. One of its largest orders is for 131 Helios enclosed arc lamps. This order was placed with the Commercial company by the managers of the St. Louis Exposition and Music Hall. The Commercial company states that its catalogue has met with a most favorable reception. In fact, the company has been flooded with requests for this handy and carefully compiled volume.

From appearances at the office of the Wagner Electric Manufacturing company of St. Louis, this concern will have more business during the fall than it can well take care of. The Wagner company is now equipped to turn out high-class appliances for almost every branch of the electrical business. Its direct current apparatus is meeting with a flattering reception, and its single-phase alternating current power motor is said to be without a peer. Manager of Sales E. H. Abadie is kept busy every moment of his time; he recently closed an especially handsome order for Wagner transformers. Mr. Abadie is kept constantly on the move, and by his good work for the company no stone is left unturned to secure business.

Not a little of the expense in brazing is due to the cost of removing the brass which has stuck to the metal where it is not wanted. The removal of this brass is usually attained only by patience and diligent filing. Now comes to the aid of the brazier that unique mineral, graphite, which is not affected by acids, alkalies, heat or cold. Braziers who have

made use of Dixon's "pure flour of graphite" pronounce it of great value. A sample will be sent without charge by the Joseph Dixon Crucible company, Jersey City, N. J., which is the only manufacturer.

The Upton long-burning "Midget" lamp in its original form, adapted to burn singly on 110 volts, has proven to be such a success that several modifications of it have been designed, including the "Midget" long-burning lamp to burn two in series on 220 volts, a "Midget" lamp to burn five in series on 500 to 550 volts and a "Midget" high-tension series lamp to burn on series arc circuits of from 4½ to seven amperes. All of these lamps, it is said, are giving remarkable results and are having a large sale. The "Midget" Upton lamp is one of the Electric Appliance company's specialties, and this company is pushing it with its usual energy.

The Electric Arc Light company of 687 Broadway, New York, manufacturer of the Pioneer enclosed arc lamp, is to be congratulated on the success it is having with its lamps, especially within the last 60 days. It has within that period closed some large contracts, and the following are among those who will soon enjoy the advantages of the enclosed arc system of lighting as furnished by the Pioneer lamp: Jas. A. Hearn & Son, Fourteenth street, New York, 135; Abraham & Strauss, Brooklyn, 300; Callender, McAuslin & Troop company, Providence, 76; Flint & Kent, Buffalo, N. Y., 60; Seventh Regiment Armory in New York city, 105.

The price of Gale's commutator compound has been reduced one-third. Speaking of this reduction, Mr. Isaacs, secretary of K. McLennan & Co., states that there would be no reduction in quantity or quality, but alone in price. There are several reasons for this reduction, he said. For one thing, the former sales have been trebled. The adoption of Gale's commutator compound by nearly every electrical power plant and central station and by a vast number of isolated plants has more to do with the reduction than any one other cause; as, in fact, it has made possible the other reasons, that of improved new machinery and direct importation of ingredients. The latter will result in large saving, and it is proposed to give the users of the compound the benefit. The reduced price will prevail for all supply houses, and free sample sticks will still be furnished to the few, if any, who have not, as yet, tried Gale's.

The Miller-Knoblock company, South Bend, Ind., whose electric street sprinkling cars are well known, is adding to its already large business an electrical department, which will be under the direct supervision of Mr. A. W. Morrell, an experienced electrical engineer and constructor, who has had years of experience in street railway motor work. It is the intention of the company to manufacture and carry in stock, ready to ship at a moment's notice, Morrell's improved assembled motor commutators for street railway motors. The fact that street railway men can procure assembled commutators for any and all standard street railway motors will be appreciated. The company will also carry in stock armature coils for all the standard motors. A complete equipment for the rewinding of armatures has been put in. Mr. Morrell, who has charge of the electrical department, has had long experience in electric street railway work, and is well known at St. Louis, Minneapolis, Indianapolis and Cleveland, where he has had charge at different times of important works.

ILLUSTRATED ELECTRICAL PATENT RECORD.

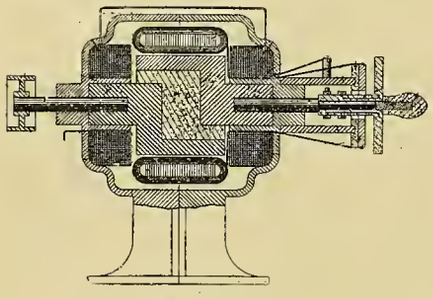
Issued August 24, 1897.

588,591. Electric Battery. William Mills, Elizabeth, N. J. Application filed November 30, 1896.

The element is formed of a plate of zinc, a recess being formed in one of its edges, the vertical walls of the recess being reinforced, a screw-thread being formed in the walls of the recess, and a supporting bushing being provided with an external screw-thread for engaging the first mentioned screw-thread.

588,592. Electric Battery. William Mills, Elizabeth, N. J. Application filed November 30, 1896.

The construction of the cell, cover and bushing contains special features, the bushing having a head and body, a boss formed on the exterior of the body at the junction of the head and body, a hole formed in the cover, and a seated recess formed in the top of the cover at the hole for receiving the boss.



NO. 588,602.

588,602. Dynamo-electric Machine. Lewis C. Rice, St. Louis, Mo. Application filed November 4, 1896.

The machine has a stationary armature, a stationary field magnet or magnets, a rotating inductor magnet having poles of opposite polarity magnetically insulated from each other, and a casing completely inclosing the armature, field magnet or magnets and inductor magnet, and forming part of the magnetic circuit.

588,610. Electric Arc Lamp. Thomas Spencer, Philadelphia, Pa. Application filed November 16, 1896.

This is an inclosed arc lamp adapted to be operated by an alternating current with opposed solid carbon electrodes, an inclosure for the proximal ends of the electrodes, a choking coil in electric circuit with the electrodes, an automatically movable core for the choking coil, and means connective of the core and one of the electrodes, whereby a reciprocatory movement of the core may be imparted to the electrode.

588,629. Igniter for Explosive Engines. Leon Bly, Decatur, Ill. Application filed December 26, 1896.

Characteristics particularly mentioned are as follows: A group of separated contact points, a single contact point adapted to strike against the members of the group successively when suitable motion is given to the group or to the point, a source of electrical energy, an induction coil and ignition points, one terminal of the source of electrical energy being electrically connected with the group of contact points, the other terminal of the source of energy being connected with one terminal of the primary winding of the induction coil, the other terminal of the induction coil being electrically connected with the contact point, and the terminals of the secondary winding of the induction coil being electrically connected, one with each ignition point.

588,669. Electric Wick-lighting Device. Henry Van Hoevenbergh, New York, N. Y. Application filed May 5, 1896.

A high resistance electrical conductor is located adjacent to the upper end of the wick-tube, one end of the conductor being in electrical contact with the body of the lamp and the other end insulated from the lamp and in contact with one pole of an electric battery carried by the lamp; an electric lead extends from the other pole of the battery to a contact point insulated from the body of the lamp, and a wick-raising mechanism is provided with a contact point adapted to be automatically brought into contact with the last-mentioned contact point when the wick is raised.

588,683. Electric Lighting System. Frederic W. Lord, Boston, Mass. Application filed June 19, 1897.

A two-way lamp socket is a feature, comprising means for making contact with a lamp, three contact points connected to leading-in wires, and means for connecting one of the points to either of the other two through the lamp contacts.

588,686. Electric Cut-out. Norman Marshall, Boston, Mass. Application filed May 29, 1896.

The method of interrupting electric arcs formed between two circuit terminals normally connected by fusible material consists in creating a substantially large gaseous or air pressure by the heat generated by the melting of the fusible material and consequent formation of the arc, and causing the same to pass in a smaller or restricted amount across the plane or path of the arc formed between the terminals at a different point from that at which the pressure is created.

588,692. Armature for Induction Motors. Abe L. Cushman, Concord, N. H. Application filed August 15, 1894.

Provision is made for a core having a short-circuiting ring at one end and short-circuiting ring segments at the other, and two or more interiorly connected plates insulated from each other, a series of energizing coils externally arranged upon the core, one end of each coil connected to the plates, and the opposite end closed on the short-circuiting ring, spring-actuated levers pivoted within the core and provided with plates insulated from each other and adapted for contact with those of the core, and coils provided within the core and composed of separate insulated wires of varying degrees of resistance, one end of the interior coil being attached to the plates of the core and the other to the plates of the levers.

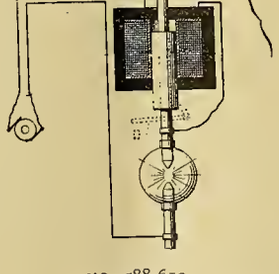
588,695. Electric Burglar Alarm. Harry M. Dumas, Detroit, Mich. Application filed August 24, 1896.

With a normally closed main circuit there are a normally open shunt in the guarded building, a door guard-switch in the main circuit adapted to close the shunt, a branch of the main circuit around the guard-switch, and a lock or switch outside the door for opening and closing the branch.

588,701. Station Indicator for Tramway or Other Cars. Henry W. Langschmidt, Brooklyn, and Richard F. Le Brocq, New York, N. Y. Application filed October 16, 1896.

An electrical switch, consisting of a main disk or plate, segmental plates secured to one side thereof and insulated therefrom, a spring-supported and spring-operated switch-bar mounted between the segmental plates and insulated from the main disk or plate, the switch-bar being adapted to be turned so as to form a contact with the segmental plates, binding posts secured to the main disk or plate and insulated therefrom, and provided with contact devices which bear upon the ends of the switch-bar when the latter is in its normal position, the main disk or plate being also provided with other binding posts which are in connection with the segmental plates.

588,771. Electric Connection Between Railway Rails. Ford Marsellis, Peralta, Cal. Application filed May 13, 1897.



NO. 588,610.

This device consists of curved segmental conducting plates adapted to span the space between the rails, having their opposite ends bent or curved to one side to form contact with the rail-webs, and superposed fish plates with holding bolts, whereby the conducting plates are forced into contact with the rail-webs.

588,797. Electrical Keg Register. William Kraft, Baltimore, Md. Application filed June 1, 1897.

This apparatus registers kegs as they are removed from the cellar by means of an elevator, the mechanism employed consisting of a lever which is moved by the kegs as they ascend, a roller carried thereby, plates in electric circuits across which the roller is adapted to pass, electrically operated registers in the circuit of the plates, and a finger pivoted in the lever to normally keep the circuit open, and which as the kegs pass it is deflected to close the circuit and operate the register.

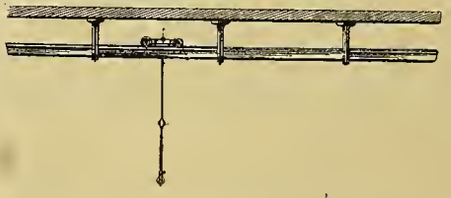
588,791. Electric Rail Bond. William B. Cleveland, Cleveland, Ohio. Application filed April 15, 1897.

An oblong frame is formed from a laterally compressed coil of flat wire arranged to have its flat sides bearing against each other, and of terminal heads and lugs cast upon the doubled ends of the frame.

588,822. Electric Arc Lamp. Benjamin F. Greene, Sheridan, Pa. Application filed April 22, 1897.

There is the combination with a clutching ring of a sleeve having a mitered end engaging the clutching ring, and a swinging frame carrying an elbow lever to engage the ring, the swinging frame connected to an armature and dash-pot to operate the clutching ring and automatically feed the carbon as required.

588,831. Electrical Transmission of Power. Emil Lanhoffer, Mülhausen, Germany. Application filed June 20, 1895. Patented in Germany May 4, 1894; in France September 13, 1894; in England February 11, 1895; in Russia June 10, 1895; in Hungary June 16, 1895, and in Austria June 27, 1895.



NO. 588,890.

An electrical regulating device, comprising a switch, means for shifting the same, a second switch operatively connected to the first-named switch, yet capable of remaining relatively stationary, stops for temporarily arresting the motion of the second switch, and yielding projections to move with the first-named switch and to shift the second switch.

588,880. Electrical Indicator for Valves. William J. Rickard, Philadelphia, Pa. Application filed October 31, 1896.

Comprised in this arrangement are an indicating device, a discharge main, a gate valve thereto, a safety valve located in the discharge main in advance of the gate valve, a hose or nozzle located in advance of the safety valve, an overflow for the latter, and an electrically operated alarm device attached to the safety valve, and adapted to be operated when the flow of water through the nozzle is cut off.

588,890. Incandescent Electric Lamp Support. Ernest L. P. Wetmore Marquette, Mich. Application filed March 13, 1896. Renewed March 27, 1897.

A carriage operated on suspended metal tracks with circuit wires connected thereto, comprising a non-conducting body having a series of holes or openings thereto, metallic side plates, screws holding the same to the body, nuts on the screws located in the holes or openings, wheels connected to the sides and engaging the tracks, the plates on the body in electric connection with the side plates, the lamp and the flexible wires thereof connected to the plates.

588,905. Active Material for Electrodes of Electric Accumulators. Siegfried Hammacher, Berlin, Germany. Application filed August 28, 1896.

The active material is described, containing a compound of lead oxide and a member of the pyridine series.

588,923. Trolley Wire Hanger. George E. Johnson, Los Angeles, Cal. Application filed June 5, 1896.

As means for attaching a trolley wire to a trolley supporting wire a connection is described in which the frame is made of one piece with a suitable insulator for preventing the current from the trolley wire from passing into the trolley wire supporting wire, and suitable screws for fastening the connection to both the trolley wire and the trolley wire supporting wire.

588,933. Electrically Operated Ship-cleaning Device. Eddy T. Thomas, New York, N. Y. Application filed April 21, 1896.

An arched frame supports the electric conductors in combination with the truck, provided with the wheels for holding the portable suspended motor and tools operated by the motor.

Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, SEPTEMBER 11, 1897. No. 11

Edison Lighting Interests.

The interests that will be represented next week at Niagara Falls in the Edison convention form a remarkable organization. It is wholly unlike any other trade or technical body in this country or abroad, and is really a magnificent monument to the great master mind whose work forms the foundation upon which the business of the members is built.

The Association of Edison Illuminating Companies comprises the central station companies of the country operating under licenses from the Edison Electric Light company of New York. It was formed in 1883, not long after the Edison central station system had been put into commercial use, and from its inception it has proved a great help to its members. The object of the organization is mutual business advancement, the comparison of data and discussion of methods of operation. The first president of the association was James S. Humbird, who was afterward connected with the Westinghouse company, and is now president of the Washington Carbon company. From the first the organization has grown steadily and has partaken of the general prosperity which the Edison interests have enjoyed. Samuel Insull, who is now president of the association, has been closely identified with Mr. Edison since February, 1881, and is now president of the Chicago Edison company. He has watched the development of the Edison system from the experimental stage and the growth of the central station business from the formation of the first Edison Illuminating company in New York down to the present day, when there are 63 Edison central station companies scattered throughout the country, employing upward of $100,000,000 capital. These local companies hold licenses from the Edison Electric Light company of New York to operate under Mr. Edison's patents in their respective territories.

Thomas A. Edison

The parent company, which, by the way, is now owned by the General Electric company, was formed for the purpose of providing funds for Mr. Edison's experimental work in the development of what is now known as the Edison system of electric lighting. The preliminary steps in the formation of this corporation were taken in 1878 by Grosvenor P. Lowrey, a prominent lawyer of New York, and the organization was completed early in 1879. The immediate cause of the organization of this company was the intense public interest in the work of Mr. Edison in the development of a general system for the electrical distribution of light and power from a central station, and the utilization of the current in incandescent lighting. The articles of incorporation were filed on October 17, 1878, the incorporators being Thomas A. Edison, Tracy R. Edson, James H. Banker, Norvin Green, Robert L. Cutting, Jr., Grosvenor P. Lowrey, Robert M. Gallaway, Egisto B. Fabbri, George R. Kent, George W. Soren, Charles F. Stone, Nathan G. Miller and George S. Hamlin. The object of the company, as announced in the articles of incorporation, was "to own, manufacture, operate and license the use of various apparatus used in producing light, heat or power by electricity." It will be seen, however, from the subsequent history of this company, that it was not deemed wise to take advantage of all the powers conferred upon it through these articles of incorporation, and that it never really engaged in the manufacture and sale of apparatus or the operation of central stations. Several of the incorporators were personal friends of Mr. Edison; they had great confidence in his ability as an inventor and an engineer, and many of them had gained material benefits through previous inventions of an electrical nature which he had made. There were other prominent men identified with this movement who saw the possibilities in this field and who regarded Edison as the most likely person to solve the problems and overcome the obstacles which had proved unsurmountable to other inventors. In the list of members of this company in its early days are to be found the names of J. Hood Wright and Ernesto P. Fabbri, partners in the banking house of Drexel, Morgan & Co. Norvin Green, Tracy R. Edson and James H. Banker, who were connected with the Western Union Telegraph company, and who had witnessed Mr. Edison's remarkable success in the telegraphic and telephonic fields, became subscribers because of their implicit faith in his ability and inventive genius. Robert L. Cutting, Jr., who was mentioned among the incorporators of the company, was a member of the illustrious family of that name and father of the gentleman who now bears it. He lent valuable aid to the enterprise in its early days. Henry Villard, who was induced to join the movement, has ever since been interested in electrical securities, and Edward D. Adams, president of the Cataract Construction company and promoter of the Niagara Falls electric power development scheme, was one of Mr. Edison's chief supporters at that time. Calvin Goddard, who was one of the builders of the Chicago Alley "L" road, and has been identified with many other large public improvements, was secretary of the original Edison company early in its history.

With the support of such an aggregation of capitalists and combination of progressive business men it might reasonably be expected that every feature of the electric lighting and power distribution system would be vigorously pushed, but the company contented itself with granting licenses to local companies for the operation of central stations, and at an early period in its history decided not to engage in such a precarious business as the manufacture of electrical apparatus was considered to be at that time. An entry in an early minute-book of the company records the adoption of a resolution declaring this to be the policy of the concern. Another important feature of the management of this property, which was adopted at the

formation of the company and strictly adhered to throughout its career, was the settlement of the terms upon which patent rights were granted to operating companies for their respective territories. Of course it was to be expected that part of the purchase price of these privileges would be paid in securities issued by the local companies, and in order to protect the value of these securities an agreement was exacted regulating the issuance of the remainder of the securities. It was stipulated in this agreement that all the stock of the local company not paid to the parent company must be subscribed for at par. As a result of this policy the stock of every local company held by the parent company was really an equivalent of its face value, and to this policy can be attributed the general strength of Edison securities throughout the country. Good management has, of course, added considerably to the natural stability of these properities and good fortune or the magic influence of Edison's name has further enhanced their value.

At the time of the formation of the Edison Electric Light company Mr. Edison was conducting his experiments at Menlo Park, N. J., where he had established his laboratory in 1876. His principal assistant at that time was Charles Batchelor. Edward H. Johnson, on his return from Europe, where he had been engaged up to 1880 in promoting Mr. Edison's telephone enterprises, became enlisted in the management of the Edison interests. At a later period Mr. Johnson became president of the Edison Electric Light company, succeeding S. B. Eaton, and continuing in that capacity up to the formation of the Edison General Electric company. John Kruesi, now with the General Electric company at Schenectady, was foreman of the experimental machine shops at Menlo Park during these early experiments, and he continued to be closely associated with Mr. Edison and the Edison enterprises up to the formation of the General Electric company, when he joined his interest with that corporation. Mr. Kruesi contributed valuable service in working out the details of the many perplexing problems involved in the development of the Edison system, particularly the underground conduit. It should not be forgotten that from the very start Mr. Edison contended that the distribution of electric current for incandescent lighting should be accomplished by means of an underground system. Mr. Kruesi's work did not end with the solution of the underground problem, but his services were utilized in the organization of the Edison shops at Schenectady, which were established in 1886 by Mr. Insull. He was selected to act as Mr. Insull's assistant at the Schenectady shops, and he has since remained there. Other valuable assistants to Mr. Edison at that time were Francis R. Upton and Charles E. Clarke, who acted as mathematicians; Prof. Edward L. Nicholls, now of Cornell University, who has gained considerable distinction through his valuable experimental work and contributions to electrical literature; J. H. Vail, now engineer-in-chief of the Edison Illuminating company of Philadelphia; Francis Jehl of Hardmuth & Co., the carbon makers of Vienna, Austria, and C. T. Hughes, who occupies the position of eastern manager for the General Electric company.

In the winter of 1879-80, Mr. Edison announced that he had reached a point in his experiments where he was satisfied of his ability to produce incandescent electric light commercially, and for the first time a public demonstration was made at Menlo Park. It proved eminently satisfactory and in the following winter was repeated on a much larger scale, this time upward of 1,000 lights being operated in the laboratory and in the homes of his assistants. The announcement of the success which attended Mr. Edison's efforts at this time caused a remarkable flurry in financial circles, not only in this country but abroad, and created a panic among holders of gas securities in London and Paris. A special cable dispatch published in the New York Herald at the time contains the following interesting statement: "In gas securities there is a perfect panic. Owing to the publication of Prof. Edison's discovery for the distribution of the electric light some gas stocks fell 12 per cent."

The public exhibition of electric lighting at Menlo Park in 1880, which was witnessed by thousands of persons, many of whom had come from distant points, has an especial interest to the electrical fraternity, because of the fact that it was the first public demonstration on a large scale of the practicability of a system employing constant potential and varying current, and, moreover, because the distribution was accomplished by means of underground conductors, embodying the essential features of the Edison system of to-day. It will be interesting to recall the fact that in Mr. Edison's earliest expressions upon this subject he displayed a remarkably clear conception of the requirements of a practical system for the distribution and utilization of current for electric light, heat and power. In an interview published in the New York Sun, on September 16, 1878, he is reported as saying: "These wires must be insulated and laid in the ground in the same manner as gas pipes. I also propose to utilize the gas burners and chandeliers now in use. In each house I can place a light meter, whence these wires will pass through the house, tapping small metallic contrivances that may be placed over each burner. * * * * With the power you can run an elevator, a sewing-machine, or any other mechanical contrivance that requires a motor, and by means of the heat you may cook your food. To utilize the heat it will be necessary to have the ovens or stoves properly arranged for its reception. This can be done at trifling cost." Again in the New York Tribune of September 28, 1878, Mr. Edison is reported to have said: "There is no difficulty about dividing up the electric current and using small quantities at different points."

An unfriendly critic of Mr. Edison, after mentioning the first exhibition of incandescent lighting at Menlo Park and the progress made up to 1881, says: "The public exhibition at Menlo Park had already, in the minds of intelligent and competent critics, established beyond question the practicability of incandescent lighting." Mr. Edison likewise was satisfied with the result of his experimental work, and in February, 1881, he abandoned his laboratory and established himself in New York, where he at once became engrossed in the exploitation of the electric light commercially. The Edison Electric Light company fitted up a brownstone mansion at 65 Fifth avenue for the purpose of demonstrating the practicability of the incandescent electric lighting of dwellings, offices and for commercial uses generally. The details of this enterprise are so graphically related by Richard N. Dyer in his paper upon "Development in Electrical Fixtures," published on another page of this issue, that it is unnecessary to give more than passing mention to it here, although the event was fraught with interest to the electrical fraternity and the entire community. At this time, it must be remembered, an experimental system only had been produced; nothing commercial was in existence. The exhibition at Menlo Park had been the most pretentious effort of the kind that had yet been made. There was no electrical manufacturing company to turn out apparatus for the production of electric light and power. There were no factories and no facilities of any kind for

SAMUEL INSULL, PRESIDENT OF THE ASSOCIATION OF EDISON ILLUMINATING COMPANIES.

manufacturing purposes at Mr. Edison's command. Everything had to be made, and he had nothing with which to make it. The directors of the Edison Electric Light company were opposed to engaging in the manufacturing business, as has already been explained. Yet, in spite of these conditions, so unbounded was the confidence of capitalists in Mr. Edison, even at this early day, that stock in the Edison Electric Light company of a par value of $100 sold as high as $2,000 and sometimes $3,000 per share.

Mr. Edison had long realized the absolute necessity of having shops under his own control, where he could have his apparatus manufactured according to his own ideas, and now having brought his system through the experimental stage to the point where he considered it commercially practicable, he set about the formation and organization of a comprehensive system of manufacturing establishments for this purpose.

In the fall of 1880 the first incandescent lamp factory was built at Menlo Park. It was established by Mr. Edison in company with Messrs. Batchelor, Upton and Johnson, who had formed a partnership for the purpose of manufacturing lamps under contract with the Edison Electric Light company, Francis R. Upton being the manager of this concern. The establishment was subsequently removed to Harrison, N. J., and occupied the premises of the present lamp works of the General Electric company. The original lamp factory at Menlo Park was destroyed by fire after its abandonment.

Next in order was the formation of the Electric Tube company for the manufacture of underground conductors to be used in the Edison system. This company was started in February, 1881. It opened its shops at 65 Washington street, in the lower part of New York, and it was there that many details of the most perplexing problems involved in the underground system were worked out under the personal direction of John Kruesi, who was general manager and treasurer of the company. Too much credit cannot be given to Mr. Kruesi for his valuable work in this department. The Electric Tube company was composed of Mr. Edison, Mr. Kruesi, and several partners in the banking house of Drexel, Morgan & Co. Later on the Tube company was absorbed by the Edison Machine Works, which was organized to make heavy machinery, including dynamos and motors, and was owned by Mr. Edison and Mr. Batchelor at the time of its formation. Mr. Insull and Mr. Kruesi subsequently became interested in the company. The shops were located at the old Ætna Iron Works, where John Roach, the famous shipbuilder, laid the foundation for his fame and fortune. Mr. Edison leased these works on March 1, 1881, and it is an interesting incident in the career of Mr. Insull, who had just arrived in this country, that the first service he performed for Mr. Edison was in connection with the establishment of the Edison Machine Works in this plant. In the winter of 1885 the Edison Machine Works were removed to Schenectady by Mr. Insull, with the assistance of Mr. Kruesi. Two of the old shops, which are still standing, were occupied by the Edison Machine Works, which at that time employed 250 men.

It was still necessary to provide for the manufacture of electrical specialties, small supplies and fittings of all kinds. Sigmund Bergmann, who had been employed in the seventies as a mechanic in Mr. Edison's shops at Newark, was at this time running a small shop in Wooster street, New York, in partnership with Edward H. Johnson, for the manufacture of telephones. They were induced to devote their time and the facilities of their small establishment to the perfection of electrical devices, such as sockets, cut-outs, switches, fixtures, electroliers and similar supplies. A partnership was formed between Mr. Edison, Mr. Johnson and Mr. Bergmann to conduct this business, and a large shop was purchased at the corner of Avenue B and Seventeenth street, New York, where the business was conducted under the name of Bergmann & Co., until it was removed to Schenectady.

This was the condition of the business in 1881, when Mr. Edison established his headquarters in New York. The Edison Electric Light company owned the patents of Mr. Edison, the Edison Lamp company manufactured incandescent lamps, the Edison Machine Works built dynamos, motors and other heavy apparatus, the Electric Tube company made underground conductors, and Bergmann & Co. furnished the electrical sundries for inside lighting. It will be noticed that in all of these enterprises Mr. Edison occupied a prominent position, and it should be explained that the bulk of the capital required for the development of these enterprises was supplied by him personally. Those who were interested with him at that time say that he carried the burden. He invested in these manufacturing concerns the proceeds of his telephone and telegraph patents, designed the apparatus used and everywhere displayed remarkable ability in the organization and development of this stupendous undertaking. He had absolute faith in the incandescent lighting system, which he had invented, and he succeeded not only in impressing capitalists with faith in his work, but he is said to have inspired his assistants and associates with absolute confidence in his ability to solve the most abstruse and difficult problems by the sheer force of his inspirational genius. Mr. Edison was at that time considered by those about him, as he is now generally acknowledged by the entire civilized world, to be the greatest inventor that the world has ever produced, an engineer of profound ability and one of the great master minds of the century.

While the organization of the several manufacturing concerns was taking place, the Edison Company for Isolated Lighting, operating under the auspices of the Edison Electric Light company, was formed in 1881, and in 1882 it engaged in the installation of isolated plants. This concern was afterward absorbed by the Edison Electric Light company, and the isolated business was taken over by the manufacturing interests under the name of the United Edison Manufacturing company. In 1889 the Edison General Electric company was formed for the purpose of consolidating all the Edison manufacturing companies with the Edison Electric Light company. Up to this time the influence of the latter corporation had predominated, owing to the fact that the patents covering the Edison system were owned by it. Subsequently, however, the manufacturing interest became the controlling factor, changing the entire complexion of the business. The first president of the Edison General Electric company was Henry Villard, who had long been interested in enterprises of Mr. Edison. The active management of the business, however, was placed under the personal supervision of Samuel Insull, who was vice-president of the company. Mr. Insull continued to be the active manager up to the time of the formation of the General Electric company, when the Thomson-Houston company was consolidated with the Edison General Electric company. At the time of the formation of the General Electric company the business of the Edison General Electric company had reached $10,000,000 a year.

While Mr. Edison and his associates were engaged in the formation and development of the manufacturing and construction companies the central station interests had not been neglected. Immediately after Mr. Edison quitted Menlo Park, in 1881, the Edison Electric Illuminating company of New York began active operations. This was the original Edi-

son central station company. It had applied to the municipal government in December, 1880, for a franchise for opening the streets, and now it began the construction of its underground system, which was composed of conductors, embedded in insulating material inclosed in wrought-iron pipes and laid 18 inches below the surface of the street. The first central station plant of the country was, however, built in Appleton, Wis., while the preparations for the work in New York were being made. The capital necessary for building the large station at New York was subscribed by the individual stockholders of the Edison Electric Light company, and it is a significant fact that Mr. Edison was the largest individual stockholder in this concern, and that he remained so for many years, thus showing his implicit faith in the commercial practicability of his central station system. Mr. Edison directed the designing of the plant, the laying out of the underground system and the building of the apparatus to be employed. The station at 255 and 257 Pearl street, opposite the old United States Hotel, was finally completed and was operated until a few years ago.

It may be of interest to recall the fact that this original Edison plant was composed of direct-connected units and that the engines were run at a speed of 350 revolutions per minute. They were supplied by the Arlington & Sims company of Providence and the Southwark Foundry and Machine company of Philadelphia. It will be seen, therefore, that the best engineering practice of the present day supports Mr. Edison's original ideas. The Pearl street station in New York was completed in the autumn of 1882, and the machinery was started for the first time on the afternoon of September 4th. The work of construction of the underground system had progressed fairly well, and at the time the company began supplying current there were 85 buildings wired for 2,323 lamps. So popular did the new light prove that in April, 1884, it was announced that the central station was supplying current to 11,272 lamps located in 500 residences and places of business. A corresponding increase in the isolated business was also shown, the number of Edison plants in use at that time being officially stated as reaching 307, with a capacity for supplying 59,173 lamps. The original investment in the first central station in New York was $1,000,000, and it is a remarkable fact that a dividend was paid upon the stock before any additional money was invested in the plant. In fact, the company had been operating scarcely a year when the business was on a paying basis.

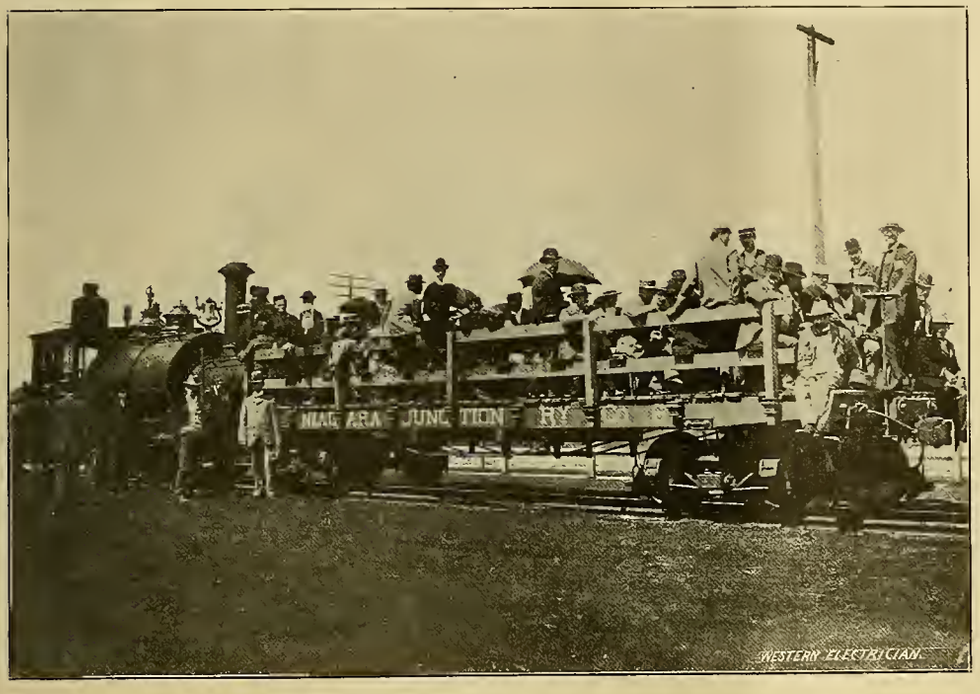
While the work of installing the Pearl street plant and developing the central station business in New York was in progress, the formation of several small central station companies throughout the country was undertaken, but no enterprise of particular interest was started at that time. Everything seemed to hinge upon the success of the New York company. It was not until five years later that an Edison station was started in Chicago, and at that time the complete success of the Edison system had been established.

After the Edison interests had been merged into the General Electric company, and the identity of the original Edison companies thereby obliterated, there was a general shifting around and many of the old Edison men retired from the electrical business. At the present time it is believed that of all the men who were prominently associated with Mr. Edison in his earliest experimental work in electric lighting only three remain identified with the electric lighting business. These are Samuel Insull, president of the Chicago Edison company, who is also president of the Edison association and of the National Electric Light association; John Kruesi of the General Electric company, who still remains at Schenectady, and Charles T. Hughes, the eastern manager of the General Electric company. There were many others, of course, who occupied subordinate positions, and still more, who were associated at a later period, who are now prominent in electrical affairs, and it is hoped that many of them will attend the Niagara meeting, which in a measure will partake of the nature of a reunion.

British Scientists' "Outing."

By Orrin E. Dunlap.

When the members of the British Association for the Advancement of Science visited Niagara Falls they inspected the power station of the Niagara Falls Power company, and then boarded the "directors' car" of the Niagara Junction Railway company, which was placed at their disposal by Superintendent Wheeler, for a trip over the road in order that they might get a good idea of the lands owned by the Niagara Falls Power company, of which the Niagara Junction Railway company is an allied concern. The day was beautiful, and the ride over the company's lands to the factories they were permitted to inspect was most enjoyable. The illustration shows the party "all aboard" for the trip standing close to the power house. Clemens Herschel, the eminent hydraulic engineer, who was consulting hydraulic engineer of the Cataract Construction company during the period of construction, is seen hanging on to the brake. The two gentlemen standing to the left near the engine are Secretary Rankine and Resident Engineer Brackenridge. No doubt Western Electrician readers will be able to pick out many more familiar faces from such a highly interesting group of notables.



BRITISH SCIENTISTS' "OUTING."

First Trip Around the Union Loop.

The first train to make the entire circuit of the Union elevated loop in Chicago was run on Sunday by the Lake Street Elevated Railroad company. It consisted of a motor car and three trailers and carried as passengers the officers and most of the directors of the Lake Street "L," as well as the heads of the various departments. The test was pronounced successful. In a few days the trains of the Lake Street and Metropolitan lines will begin using the structure. Three complete circuits of the loop were made, causing much interest in the downtown section. The impression was created that the loop was at last in operation, and the platforms along the line soon were filled with people anxious to take a ride. It required the efforts of 50 specially assigned employes to clear and keep clear the platforms at the various stations. Switches, curves and signals were carefully examined, and everything was said to be in perfect condition.

Lightning Liberated a Canary Bird.

[From the Lewiston Evening Journal.]

Lightning sometimes plays queer freaks, as when it melted the wire from which hung a Berwick canary's cage, the cage falling to the floor and liberating the bird, which was not hurt a bit.

Development of Electrical Fixtures.[1]

By Richard N Dyer.

To a manufacturer or dealer who entered the business after the present constructions had become standard, and without knowledge of the travail which preceded that result, electric and combination pendants appear to be only the ordinary gas fixtures with the wires and insulating joints added, and with such simple changes in construction as are required to accommodate those additions. Back of this, however, there is a history which has never been and probably never will be fully written, and which is known only in part to those few manufacturers and dealers who participated in the early introduction of the incandescent electric lamp.

That lamp was invented by Mr. Edison in the summer and fall of 1879, and was publicly exhibited in operation on a considerable scale at Menlo Park, N. J., during the Christmas holidays of that year. The exploitation of this lamp as a substitute for gas for interior illumination was undertaken by the Edison Electric Light company. During the year 1880 the only plant worth noting was that on the steamboat Columbia, of the Oregon Navigation company, plying between Portland, Ore., and San Francisco, Cal. This boat had oil fixtures to which were added crude attachments for supporting incandescent lamps. The fixtures were made by Williams, Page & Co. of Boston, Mass. They were of special construction, which have never been repeated, and which furnish no indication of how to build pendants suitable for general use for the lighting of houses.

In February, 1881, the Edison Electric Light company rented the dwelling house No. 65 Fifth avenue, located on the east side of Fifth avenue just south of Fourteenth street. It undertook to equip this building with a complete electric lighting plant which would show the possibilities of the incandescent lamp for interior lighting, both for office and household uses. The rooms were to be provided with pendants corresponding in number and location to those which had been used in the house for gas, with a newel post standard, with a slide fixture, and with brackets. All these fixtures were for electric light only, no combination arrangements being included. The slide fixture and the brackets were of special constructions, and are not interesting for the purposes of this paper. The contract for these fixtures was given to Mitchell, Vance & Co. on specifications furnished by the Edison Electric Light company. Mitchell, Vance & Co. did the metal work, and called in Charles R. Hinds, a gas-lighting electrician of reputation, to furnish the electrical devices in accordance with the specifications. The fixtures were built on a patented idea of Mr. Edison involving the "knock-down" principle. They were brass finished fixtures, of a selected design for gas work, and were provided with large bodies open at the bottom, and in these open bodies were located large circular blocks of vulcanized fiber, upon which the electrical connections were made. Each arm of the fixture was wired complete, and the wires terminated at the inner end of the arm in two insulated contacts corresponding in principle to the contacts on the base of an incandescent lamp. The block of vulcanized fiber secured in the body of the fixture was provided for each arm with a set of insulated contacts corresponding in principle with the contacts in a lamp socket. The object was to enable the connections between the arm wires and the main or stem wires to be made by simply screwing the arm in place, and thus the fixture arms could be wired complete and the fixtures taken apart or "knocked down" for shipment without disturbance of the wiring. The fixtures were not provided with any main stem wires by the manufacturers. These were to be provided by leaving the wires projecting from the outlet of sufficient length to enable them to be drawn through the pendant to its lower end and there secured by screws to the proper contact plates on the block of vulcanized fiber in the bodies of the fixtures.

The arrangements just described were actually carried out, the main wires being passed through the outlets by putting in T connections with the horizontal pipes in the ceiling, which T connections had openings at the center of the T for permitting the main wires to be run directly down through the outlet. The fixtures were delivered on March 15, 1881, and Luther Stieringer, at that time employed by Mitchell, Vance & Co., was given the work of erecting the fixtures. Stieringer was to have nothing to do with the electric work; that was in charge of an electrician for the Edison Electric Light company. Difficulties arising from bad contacts, ground connections, etc., were soon developed; and after considerable tinkering to overcome these difficulties, Stieringer, with the consent of the Edison company, took out the electrical contrivances in the fixtures and rewired them on the simple plan, at present employed, of soldering and tapping the joints between the stem and arm wires; and to avoid still other difficulties he opened the line of piping back of each fixture, leaving an air gap which cut off the fixture from the ground formed by the house piping. The result was satisfactory, and the electrical difficulties disappeared.

From this work Stieringer was brought to an appreciation of the fact that if internally wired fix-

1. Read before the National Fixture Dealers' association, at Niagara Falls, N. Y.

tures of the general design of gas fixtures were to be made useful and were to be supported from the house piping, as he believed they should be in the case of simple electric fixtures, and knew they would have to be in the case of combination arrangements, it would be necessary to provide a device which should form an effective mechanical connection between the fixture and the outlet and an effective electrical separation or insulation between those parts. This resulted in the production of the insulating joint, two forms of which (one adapted for electroliers and the other for combination fixtures) Stieringer made about this time, the work being done at night at his house. It was some time later, however, before he had an opportunity to put his ideas to the test of practice, but these insulating joints he carried around in his pocket and showed to various people in explaining his notions relating to fixture work.

During the year 1881 several manufacturing establishments were organized for making the various kinds of apparatus required for incandescent lighting by the Edison company, and an effort was made to get one or more of the gas-fixture houses to undertake the manufacture of electric fixtures. None of these houses was found willing to go to the expense of developing the new forms and devices which would be presumably required, while they were quite willing to do work at the risk of the purchaser in accordance with specifications which might be submitted to them. Their position was thought by the electric light men to be antagonistic to the new industry, and perhaps it was, in the sense that there was no certainty that the new illuminant would furnish them with the same business opportunities as did the gas which it would replace; and, naturally enough, gas-fixture manufacturers with an established line looked upon the new industry as involving experimental expense without an assured outcome.

In this situation the firm of Bergmann & Co. was organized and a small shop established for the manufacture, not only of fixtures, but of miscellaneous small devices, such as sockets, safety catches and switches, which were not within the scope of the other Edison factories. That firm undertook the electric-fixture business on lines quite independent of the gas-fixture art. Their first pendants consisted of a simple iron pipe for the stem and a large cast-iron body open at the bottom, in which the arms were screwed. The iron was given a bronze finish, and the bottom of the body was covered with a hard rubber cap, which, being black in color and presenting a different appearance from the finish of the fixture, was painfully conspicuous. A large block of wood was set in the body, and on this block were mounted plates to which the arm and stem wires were screwed. Circuit controllers having stems projecting through the hard rubber cap were also mounted on this block, as well as safety catches. These fixtures were provided with a crowfoot or with an equivalent device in the form of a closed cast-iron canopy with a flange for fastening screws, and whether provided with the crowfoot or the flanged canopy the fixture was designed to be secured to a large base of wood, which, in turn, was attached to the ceiling. The fixture as manufactured was wired complete in the arms, but the stem wires were omitted and were designed to be provided by wires extending from the ceiling which were to be drawn through the stem of the fixture and secured at their ends to plates on the wooden block in the body.

An improvement upon this construction introduced by Bergmann & Co. was a similar fixture provided with stem wires which ended in a large plug attached to the top of the stem, this plug being similar to the base of the lamp, or to an attachment plug such as now employed, but made of wood and several times larger. To the ceiling was attached a large circular block of wood having a socket corresponding to the lamp socket, in which the ceiling wires terminated. By this plan a building could be wired complete, the wires terminating in the sockets in the ceiling blocks, and the fixtures could also be wired complete and could be attached in place by simply screwing the plug on the end of the fixture to the socket in the ceiling block, making at the same time a mechanical and an electrical connection.

A number of fixtures of the two kinds described were manufactured and shipped to the Paris Exposition in 1881, and a few, particularly of the kind supported by the crowfoot or flanged canopy, were put into use in this country. During this time electricians who did not care to use the Bergmann fixtures supported their lamps by means of such expedients as came to hand. Some gas fixtures were used with wires wrapped around the outside or carried to the lamps aerially, and in some instances a partial concealment of the wires was effected; but nothing in the way of a standard of construction was adopted except in the case of these fixtures manufactured by Bergmann & Co.

In the fall of the year 1881 Stieringer wired and hung, in accordance with his own ideas, electric light fixtures in the house of J. Hood Wright in New York city, and in the spring of 1882 did similar work in the house of J. W. Doane of Chicago. Both Mr. Wright and Mr. Doane were interested in the Edison business. Having thus demonstrated to his own satisfaction the success of his plan of using internally wired gas fixtures supported by insulating joints, Stieringer applied for his patents covering the use of the insulating joint in connection with electric and combination fixtures of this character. His work, however, had not so strongly impressed the electric light people as to effect a change in the character of the fixtures manufactured by Bergmann & Co.

The recognition of the merit of gas-fixture designs for electric fixtures, and of Stieringer's method of using them, was of slow growth, and only came about by the gradual introduction of the incandescent lamp for interior illumination in locations where the users would not consent to the lack of ornamentation and artistic effect which had become a standard in connection with gas lighting. As the business grew, the frequency with which fixtures of this class were required, and the dangers from fire which their use involved, brought the subject to the attention of the fire insurance interests, who formulated rigid rules as to the separation of wires carrying the electric lighting current from each other and from other conducting bodies which, if enforced, would have prohibited the use of internally wired metallic fixtures. Indeed, the insulated wire at that time on the market was quite unsuited to the work, and it is questionable whether the fire insurance underwriters would ever have permitted the internal wiring of metal fixtures as a regular practice if improved forms of insulation had not been developed.

Stieringer's plan of introducing an insulating joint between the fixture and the outlet reduced the danger considerably, and in 1884 the New England Insurance Exchange adopted a rule requiring the employment of insulating joints when fixtures were hung from grounded supports. This requirement, which was adopted later by fire insurance underwriters throughout the country, together with the improved forms of insulated wire which were developed, resulted in the general adoption of the present standards of construction in the electric-fixture business, and the gas-fixture manufacturers, commencing first with the larger houses, and extending subsequently throughout the trade, took up the manufacture of electric and combination fixtures as a part of their regular business.

A review of the entire situation shows that it was the insulating joint and the ideas involved in its use which led to the present universal employment of gas-fixture designs for electric and combination fixtures. Without the insulating joint, a form of insulated wire having a high insulation protected mechanically by some armor which would prevent abrasion might have been finally developed and would have enabled the safe internal wiring of metal fixtures without the use of the insulating joint. Such an improved insulated wire might have been produced as the result of the pressing demand for it in the absence of the insulating joint; but it is apparent that with the imperfect insulations which existed in the early days of the electric lighting art, and which still exist, the insulating joint is the foundation upon which the present electric-fixture art rests. That joint and its use in this connection were invented by Stieringer and are covered by his patents, to which, in view of the meritorious results accomplished, full credit should be given.

Surprised by Lightning.

[From the Kansas City Times.]

Lightning struck J. H. Engle of Abilene on the shoulder the other night, and ran down his leg and out through his boot. He was surprised for a minute or so.

Suburban Railroad.

John M. Roach, vice-president and general manager of the North Chicago and West Chicago Street Railroad companies, has been elected president of the Suburban railroad, which is now, in effect, a Yerkes line. Mr. Holcomb of Naugle, Holcomb & Co. was elected president of the road following its partial reorganization and the settlement of differences with C. L. Leeds some time ago. The connection which the Suburban is to build with the Lake Street road will make the latter the desirable line for suburban passengers to take in coming down town, and it is expected to largely increase the traffic of that road. The Northern Pacific leased lines, which are now operated by the Suburban Railroad company as a steam road, are being rapidly converted, and it is expected they will be operated by electricity some time during next week.

Western Union Claim Allowed.

Reference was made in this journal last week to the claim of the Western Union Telegraph company against the government for messages transmitted during Mr. Wanamaker's administration of the Postoffice Department, and for which, as was claimed, inadequate remuneration was made. The report of Perry S. Heath, the first assistant postmaster-general, acting as referee in the controversy, was filed in the Court of Claims at Washington on September 4th. The contention of the telegraph company is sustained. The essential paragraphs of the report are as follows:

"I find that the amount which would be due for the telegraph service rendered by the claimant to the defendant for the period embraced in the claimant's petition (July 1, 1889, to June 30, 1893), at the rates of tolls for telegraphic service fixed in the orders of the Hon. J. Sterling Morton, secretary of agriculture, and Wilson S. Bissell, postmaster-general, respectively, aggregate $258,869.84. The gross amount of the service rendered by the Western Union Telegraph company during the period was $610,470.18. The payments made by the government through its various executive departments to the Western Union Telegraph company during this period amounted to $351,600.34, leaving, as stated above, a balance of $258,869.84 due for service rendered.

"The total number of telegrams involved in the audit is 1,759,500. It will thus occur to the court that the total amount of material placed in my hands to be searched and used in this audit was very large. There were more than three wagonloads of telegrams alone. The sheets and abstracts alone, the residuum of the information contained in the vast amount of raw material, would almost make an additional wagonload."

VIEW OF CONVENTION HALL AT NIAGARA FALLS.

American Street Railway Association

Arrangements have at last been completed for the exhibition that is to be held at Niagara Falls, October 19th to 22d, in connection with the annual meeting of the American Street Railway association. The building in which the convention and exhibition will be held is located at the corner of Walnut and Sixth streets, within two minutes' walk of the Niagara Falls and Suspension Bridge street railway line, and within less than 10 minutes' ride from any hotel in the city. Its location is on the highest land in Niagara county, and about midway between the two business sections of the city. Its dimensions are 150 by 125 feet.

The front of the building is two stories high, and the second floor will be remodeled in order to make

a convention hall capable of seating 300 people. It is intended that the entire ground floor shall be given up for exhibition purposes, with the exception of the space marked off in the corner, which will be occupied by the Accountants' association, an organization of street railway accountants which will meet during the convention of the American Street Railway association.

A floor plan of the exhibition hall, showing the allotment of space and the location of the exhibitors, together with the names of the companies to be represented, is presented on this page. It will be seen that 55 concerns have taken advantage of the association to bring their apparatus before street railway operating companies, 13,875 square feet being devoted to this purpose in the exhibition hall, beside the exhibition of cars on the track outside of the hall. A sidetrack has been laid in front of the building on Walnut street, for the purpose of giving exhibitors an opportunity to show their trucks and car bodies under practical conditions.

It will be noticed that the main entrance to the exhibition hall is on Walnut street. All other doors will be closed during the meeting, as it is the intention of the management to have members see exhibits if they visit the meeting hall. Access to the upper floor can only be gained by passing up one aisle, across the building, and then down another aisle, taking in all the exhibits on the way.

In order to provide ready facilities for shipments temporary connections were made with the Erie road, and for this purpose a branch has been extended to the doors of the convention hall. The building, which is in a fine state of preservation, is heated by steam and supplied with electric light and power. The sides of the exhibit room are 16 feet high, from which point the trussed, open timbered roof springs. The rooms are all well lighted and there is a commodious basement.

FLOOR PLAN OF EXHIBITION HALL — NIAGARA FALLS

SIDE TRACK

WALNUT STREET.

No. of space.	Exhibitor.	Square feet.
1	Windsor & Kenfield Publishing company, Chicago	100
2	Street Railway Journal, New York	100
3a	Westinghouse Electric and Manufacturing company, Pittsburg	920
3b	Barney and Smith Car company, Dayton, Ohio	350
4	General Electric company, Schenectady	1,100
5	Walker company, Cleveland	700
6	Wells and French company, Chicago	350
7	Cambria Iron company, Philadelphia	100
8	John T. McRoy, Chicago	100
9	Paul Jones, Cincinnati	100
10	Adams & Westlake company, Chicago	100
11	Dilworth, Porter & Co., Ltd., Pittsburg	100
12	Trojan Button Fastener company, Troy	100
13	Bridgeport Deoxidized and Metal company, Bridgeport, Conn	100
14	Corning Brake Shoe company, Buffalo	100
15	Murphy Manufacturing company, Pittsburg	480
16	Edison-Brown Plastic Rail Bond company, New York	150
17	Consolidated Car Fender company, Providence	200
18	Christensen Engineering company, Milwaukee	900
19	Cutter Electric and Manufacturing company, Philadelphia	100
20	American Railway Supply company, New York	100
21	Fuel Economizer company, Matteawan, N. Y.	100
22	Central Electric company, Chicago	200
23	E. T. Burrowes company, Portland, Me.	175
24	Forest City Electric company, Cleveland, Ohio	100
25	Pomeroy & Fischer, New York	100
26	Cleveland Frog and Crossing company, Cleveland, Ohio	150
27	D. J. Sinclair, New York	100
28	J. G. Brill company, Philadelphia	650
29	Standard Air Brake company, New York	250
30	William Wharton, Jr., & Co., Philadelphia.	250
31	Ohio Brass company, Mansfield, Ohio	200
32	Creaghead Engineering company, Cincinnati, Ohio	200
33	Falk Manufacturing company Milwaukee, Wis	200
34	R. D. Nuttall company, Allegheny, Pa.	200
35	Clarence Whitman & Co., New York	150
36	W. F. Ellis, Boston, Mass	100
37	Electric Mutual Casualty association, Philadelphia	100
38	Detroit Stove Works, Detroit, Mich	100
39	H. W. Johns Manufacturing company, New York	200
40	Pennsylvania Steel company, Steelton, Pa.	350
41	McGuire Manufacturing company, Chicago	600
42	Peckham Motor Truck and Wheel company, New York	800
43	Taylor Electric Truck company, Troy	340
44	Forsythe Bros. & Co., Chicago	100
45	Rochester Car Wheel Works, Rochester	200
46	New York Car Wheel Works, Buffalo	300
47	New Haven Car Register company, New Haven	100
48	A. O. Norton, Boston	100
49	Meaker Manufacturing company, North Chicago	200
50	International Register company, Chicago	100
51	Paige Iron Works, Chicago	100
52	St. Louis Register company, St. Louis	200
53	Johnson company, Lorain, Ohio, and Johnstown, Pa	560

TRACK SPACE.

J. G. Brill company, Philadelphia.
Duplex Car company, Boston.
McGuire Manufacturing company, Chicago.
Peckham Motor Truck and Wheel company, New York.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $3.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

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CIRCULATION, 20,000.

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With the Niagara Falls convention number of the Western Electrician, dated June 12, 1897, this journal made a new record for itself both in circulation and advertising. Of this 100-page number 20,000 copies[1] were printed and circulated and the amount of full paid advertising matter carried was 8,643 square inches.

Beginning with the convention number of March 3, 1894, the record shows constant gains each year until in the present case the number of square inches of full paid advertising matter is more than double that of the 1894 number. The figures showing this unprecedented gain are given in the accompanying table:

Issue	Number of Advertising Pages.	Whole Number of Pages.	Square Inches of Paid Advertising Matter.
March 3, 1894....	40	56	4,145
February 23, 1895.	52	68	5,593
May 9, 1896.....	72	88	7,576
June 12, 1897.....	80	100	8,643

This constantly increasing patronage speaks eloquently of the influence and merit of this journal and of the confidence and respect which it commands throughout the country. It is pleasing recognition of the efforts that have been made in the interest of the entire fraternity.

If there is one hollow sham and wretched nuisance to-day, it is that of giving and hearing evidence in the law court, and every honorable, sensible man abhors the whole proceeding.—Electrical Engineer.

Words, words, words! Down in his heart the editor of the Engineer should have a warm spot for the "law court," otherwise he would be an ingrate.

A new danger in electricity has been discovered by an English newspaper, the Surrey Advertiser, which, in the course of a description of a fire in an electrical works, says: "It was nothing short of providential that a number of dynamos stored in the building failed to explode, otherwise the damage to surrounding property would probably have been enormous." This is on a par with some of the statements that occasionally appear in American journals upon electrical subjects.

Two conventions in which electrical men are interested are to be held at Niagara Falls next week, and the outlook for large attendance is good in both cases. The street railway men have been affected by the hard times and by the bicycle, but most of the companies in the New York state association are in splendid financial condition. The Edison companies throughout the country have shown no symptoms of decline. In both meetings there will be plenty of topics for consideration, and as Niagara possesses many attractions for students of street railway, power and lighting systems, there should be a good attendance.

The proposed Pacific cable was one of the topics considered at the great conference held in June and July last between Joseph Chamberlain and the premiers of the self-governing colonies of Great Britain, and it is frankly stated in the parliamentary paper which has just been issued that much that took place in the way of discussion still remains a secret. The home government expressed its entire satisfaction with the present arrangements, but announced its willingness to have the views of the colonies on the question of a cable passing entirely through British territory. Such a cable was practicable enough, but an important consideration would be what subsidies would the several colonies be willing to grant toward the undertaking. The majority of the premiers desired this subject to be deferred until they had had time to consider the report of the committee appointed to consider the matter last year. The government will now await definite proposals from the colonies before proceeding further in the matter.

There is a curious coincidence between an article published in the Electrician of London under date of June 25, 1897, and one that we find in the Electrical Engineer of the same place of August 27th last. The former is published as original and is entitled "An Incident in the Working of the Gilgit Telegraph Line," while the later article is shorter and is credited to the Standard (evidently of London), which, in turn, quotes it from the St. Louis Globe-Democrat. The second article is headed "Perils of Asiatic Telegraphing," and appears to have been made up from the first, without credit, although it is, of course, barely possible that both may have been taken from some farther source. However, we do not believe that the St. Louis Globe-Democrat has access to the same information about the telegraphs of India that is open to the Electrician. It is entirely probable that the second story was rewritten and abridged from the first, and it is interesting to note how it traveled from St. Louis back to London, appearing in a great daily, to be copied in a second technical journal two months after the original publication.

A grave charge is brought against the telegraphic administration of the French government by the Paris correspondent of the London Times. It is asserted that Le Temps of Paris, "the well-known governmental French paper," summarized and criticized a telegram sent to the Times by its correspondent in Rome, the article appearing in Paris 12 hours before the message was printed in London. This is taken as conclusive proof that someone connected with the telegraphic service, a government employe, must have violated the sanctity of telegraphic correspondence and communicated to Le Temps the telegram in transit to the Times. Keen as is the news-gathering rivalry of the United States, we do not believe that any of the private corporations doing the telegraphic business of the country has ever been guilty of duplicity of this character. Apparently, too, in the case of the French government, the practice has been carried on for some time, for the blunder of printing the news before publication by the rightful owner is most easily explained by the assumption that long usage had made the culprits careless.

But the French government is not the only transgressor of this description, for, as was related in the Western Electrician last week, it is probable that at the next sitting of Parliament an inquiry will be made into "the unprecedented manner in which private telegrams have been seized and made public during the recent South African investigation at Westminster." Truly, one should put his trust in state telegraphs no more than in princes; private ownership is good enough.

In considering the horseless carriage from the investor's point of view, the Daily Financial News of New York says: "We must make a low-cost motor carriage. Electric storage carriages and the $2,500 machines made by one or two of our manufacturers in this line to-day are all very well for the rich, but what is needed is a $100 motor carriage, or even a $150 conveyance, which would permit popular use by everybody who now owns or seeks to own a bicycle."

Anybody can see what a fine thing it would be for all concerned if a practicable motor carriage could be retailed for $150. But it is idle to indulge in such a speculation in the present state of this new art. It is of no significance that "good buggies are now advertised at retail for $40 or $50;" and the added statement that "an engine and boiler attachment good enough for ordinary service in large quantities ought to be made for from $25 to $40 additional" shows a misconception of the facts. The "good buggy" would not be suitable, as the framework of a self-propelling carriage must combine great strength and light weight, must turn very easily and be provided with steering apparatus. In addition there must be an efficient brake, as well as expensive rubber tires of some sort to make the running as easy as possible. All the gearing must be calculated to reduce friction to the minimum, so that none of the power may be wasted.

The idea of equipping the carriage with a "good enough" engine and boiler at a cost of less than $40 is chimerical. Nothing that would unite the requisite efficiency and lightness could be produced for any such sum, to say nothing of the weight and cost of fuel and water. Moreover, there is the objection that a steam engine would frighten horses and also the fact that the pleasure of travel in summer would be marred by the heat and noise of the boiler and engine.

For pleasant riding the electric carriage is the ideal, but unless there is a great slump in the storage battery market, vehicles of this character will remain a luxury for years to come. However, electric carriages are not all so expensive as the figure given by the Daily Financial News indicates, and with increasing demand they will become cheaper.

1. State of Illinois, County of Cook—ss:
Frank Foster Kenworthy being duly sworn deposes and says that he is a resident of the city of Chicago in the county of Cook and state of Illinois, and that he is the superintendent of the binding department of the Electrician Publishing company, the publishers of the Western Electrician; that he was present at and superintended the binding of No. 24 of Vol. 20 of the Western Electrician, issued on June 12, 1897, and that there were sent out by actual count 20,000 complete copies of said Western Electrician of the volume and number above specified.
And further this affiant sayeth not.
FRANK FOSTER KENWORTHY.
Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

Electrolysis in Street Railway Work.

By G. W. Knox.

Electrolytic action on gas and water pipes, in the imagination of a great many who have not had an opportunity of knowing its extent by actual observation, assumes the shape of a mammoth octopus which reaches out, grapples with and devours everything within its reach. There is in reality no more cause for fear of the pipes being destroyed by the return currents of the railway than there is of their being destroyed by the flow of water or gas within. This may seem like a sweeping assertion; nevertheless, I believe it may be easily proven.

The railways are putting out in the shape of return copper conductors from 20 to 30 per cent. in excess of the outgoing feeders. This excess is mostly for the purpose of allowing for any breakages in the bonds or wires until such a time as the breakages are repaired. This insures an excellent return conductor for the current, which we know to be many times better than a rusty iron pipe, having a conductivity of only one-seventh that of copper, together with a multiplicity of the worst possible conducting joints. Again, it must be remembered that this flow of current has a pressure of only four to five volts, so that there is scarcely any inclination for the current to leave its good path—the copper return—and overcome the high resistance of the earth between the rail return and the pipes, and attack the high-resistance conductor—the rusty, jointed pipes.

There are, however, times when there is a tendency for the current to leave the rails and seek the pipes. This takes place when we have what may be termed the "slopping over" effect at some point on the system, which may be caused by excessive bunching of cars in case of blockades. For instance, suppose that cars are blocked at the point indicated by A in Fig. 1. The return conductors along a a are of ample capacity for the regular service but inadequate to handle the abnormal flow of current com-

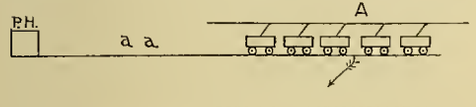


Fig. 1.

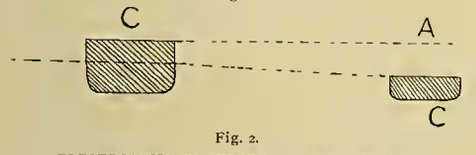


Fig. 2.

ELECTROLYSIS IN STREET RAILWAY WORK.

ing from the blockade without an increased drop This would result in there being an increased potential in the vicinity of A, and should there be extraneous conductors like pipes close enough to this locality, they will attract the overflow of current for the time, and to an extent tend to reduce the rise of potential on the return at A. It is then that there is current in the pipes, but as this is only for a period of perhaps a few minutes, no damage will be done to the pipes.

It may be argued that enough return conductor should be run out to take care of this "slopping over," but this is in no wise necessary, as a blockade is not liable to happen at any one point on the system often, and, again, the expense of putting out so much copper where its use would be called for so seldom would be prohibitory.

It is also true that no matter how large a return conductor is provided, there is certain to be a slight difference of potential between the rail and pipes. To illustrate why this happens, let us say C in Fig. 2 is a canal full of water. At C^1 is another canal running parallel to and a few inches below the first canal C. There is, of course, a difference of pressure, relatively, in the water in canal C and C^1. Now, let C represent the railway return and C^1 the pipes. We have a higher potential at C than C^1, because the cars are giving off current at C. Along the rail at C the current is pursuing its regular course back to the power station, and a small amount of current may leak over from C to C^1, which will be in proportion to the resistance of the path between C and C^1, the volume of current at C and the resistance of its path, and the resistance of the path for the current at C^1.

In this example we have the whole proposition of whether we are to have electrolytic action between the railway return and the pipes. In the first place, the path at C must have ample capacity to take care of the calculated current without excessive drop. At C^1 we have the rusty iron pipes with one-seventh the conductive capacity of the copper return and the many high-resistance joints in the line of pipes spoken of, with the high-resistance path between points C and C^1. In Chicago a sandy soil predominates, which has, perhaps, more resistance as an electrical conductor than any other soil. Taking into consideration that the return conductors exceed the outgoing conductors from 20 to 30 per cent., and that the drop of the overhead and return circuits has been determined from seven to 10 per cent., how is it possible that there should be any disastrous results from electrolytic action?

The small seepages from rail to pipes which may take place at a few points on the system, should the path by means of the pipes be ample, may result in the current being quite heavy at other places in the pipe, and should the pipes having such currents lay close enough to the rail or return there will be an inclination for the current to leave the pipes for the rail, and it is at this time that the pipes are damaged.

The only way of eliminating this difficulty is to connect the rail or return to the pipes by means of an equalizing wire, as shown in Fig. 3, which will pick all the current out of the pipes and not allow it to leave the pipes for the rail by jumping off the pipes and traveling through the earth to the rails or return.

It is believed by some that the railway companies wish to use the earth and pipes as a part of the return conductor. Nothing could be further from the facts, as this practice was abandoned several years ago, when it was proven of no value as a return conductor for the currents employed in railway work. It is highly false economy not to have ample return conductors, as it takes an increased pressure to overcome the paths of high resistance which would be offered by the pipes and earth. This, of course, is all a waste of power, which the railway companies readily comprehend.

There are times when it may be found that there is an unbalancing effect with the return, this being caused by changing the number of cars on some routes, the breaking of bond or return wires. After making tests and calculations it is sometimes found necessary to run out and tap with more copper the districts where the tests demonstrated that there was a heavy reading in volume and pressure of current between the rails or copper return and the pipes.

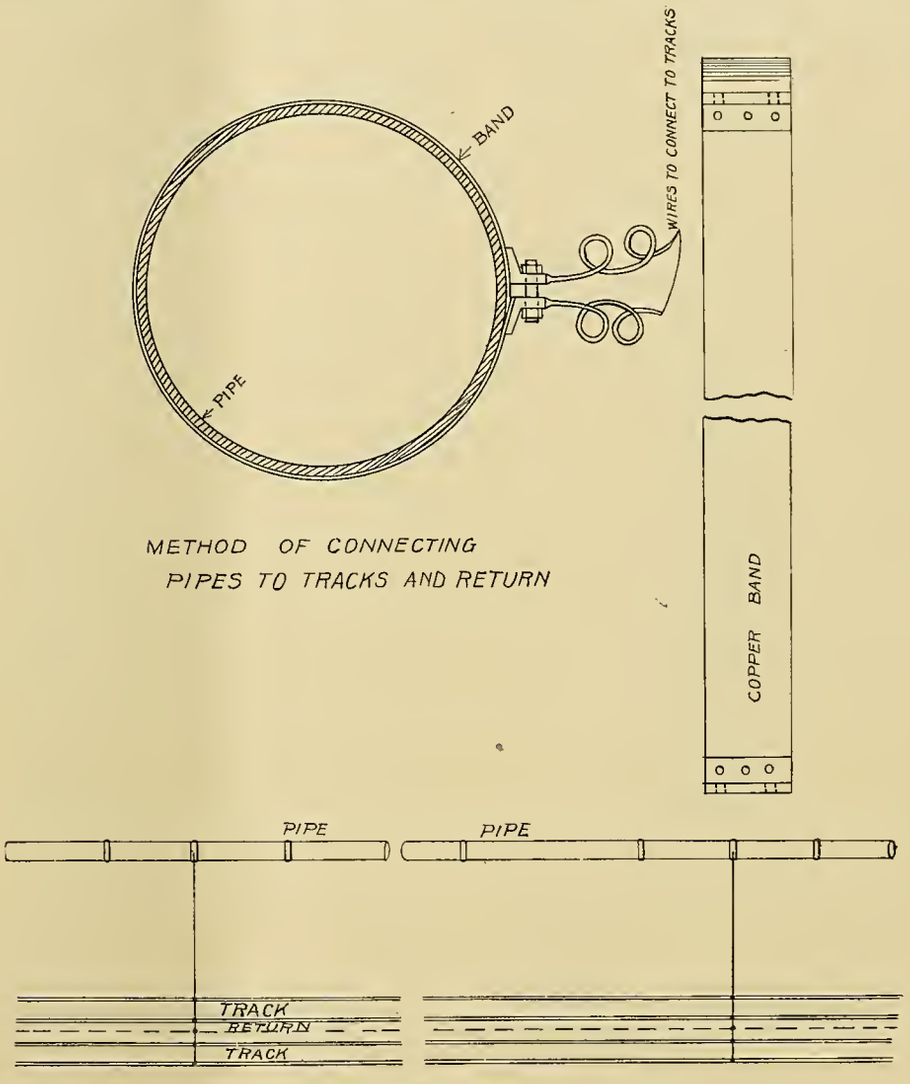


FIG. 3. ELECTROLYSIS IN STREET RAILWAY WORK.

Wabash Special to the American Street Railway Association Convention.

The Wabash road, having carried the members of the American Street Railway association to both the Montreal and St. Louis conventions, and having given them such excellent service, it has been decided by this association to patronize the Wabash to the Niagara Falls meeting. Arrangements have been made for a special train via that line from Chicago to the Falls, leaving Chicago at 3 p. m., October 18th. The Wabash now operates its own line through from Chicago to Niagara Falls, and is in position to give better service than ever before. The Wabash is the shortest line to Niagara Falls via Detroit.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the Western Electrician.]

The Blue Earth Valley Telephone company has just completed work on the telephone exchange at Wells, Minn.

The Northwestern Telephone Exchange company has completed its line between Mankato and Rochester, Minn.

The southern extension of the Dakota Central Telephone lines has reached Huron, S. D.

The Mutual Telephone company of Des Moines, Ia., has commenced regular service with 500 instruments in use.

The completion of connection by telephone with Chicago is much appreciated in Minneapolis. The sound from New York comes very clear and distinct.

The long-distance line from Davenport to Dubuque, Ia., will be completed by October 1st.

Work is being done on the telephone line between Elkport and Updegraff, Ia.

Ex-Mayor Stewart of Dubuque, Ia., has organized the Interstate Telephone and Electric company, with a capital of $100,000, to run in opposition to the Bell company.

The telephone rate war continues at Des Moines, Ia. A short time ago the Bell company cut its rate in the business districts to $24, just half its former price.

A new switchboard has been necessitated by the "good times" at Mason City, Ia.

The Western Telephone Construction company has applied for a 20 year franchise for a system at Stevens Point, Wis.

A secret meeting of the Iowa telephone companies was held at Des Moines, Ia., last week, with an attendance of 25.

A company has been organized to erect and operate telephone lines in Iowa, taking the name Chairton and Newbern Telephone company. The capital stock is $2,000, and J. N. Bowen is the secretary.

A New York firm saved $9,000 since the completion of the telephone connection between that city and Minneapolis. Austin, Frazer & Co. of New York had an attachment against the Bank of Minneapolis which, the firm knew, had a balance in the National Bank of Commerce of New York. The claim was assigned by telephone to a New York representative, the necessary affidavits were transmitted and written out, and within an hour the funds of the Minneapolis bank in the National Bank of Commerce were tied up. Eastern lawyers say there

is no question as to the legality of the proceedings.

Odebolt, Ia., people are considering the proposition to make connections with the Jefferson telephone system.

O. G. Potter, W. H. Murray and A. B. Lenhart have organized themselves into the Pepin (Wis.) Telephone company.

The Dakota Central company has equipped its central office at Milbank, S. D., in W. M. Thomas' store.

The Western Electric Telephone system of Britt, Ia., and the Dakota Central lines are arranging to coöperate, connections probably being made at Ortonville, Minn.

W. J. McAllister of Willmar, Minn., is promoting the interests of the Minnesota Central Telephone company at Clara City.

Brussels International Exhibition.[1]

By Ernest Kilburn Scott.

Although there was unusual delay in getting the exhibition ready, now that it is in full swing, it can undoubtedly claim to be a success, which is saying a good deal in a year when our Jubilee festivities have attracted so much attention. The general British section (thanks to the efforts of our executive commissioner) is well arranged and includes collective exhibits by the Cleveland Ironmasters' association, Leeds Chamber of Commerce, Machinery Trust company, and the various railway and steamship companies, the latter having a very large display of mercantile flags. The usual ship models are shown, among them being the Blanco Encalada, built by Sir W. Armstrong, and destroyed in the last Chilian war. The English sailors in attendance seem to be very popular. An interesting boat model is also to be seen at Messrs. Cook & Sons' stall. It was found in a tomb in Upper Egypt, and represents a funeral boat used for carrying the dead across the Nile for burial. It is estimated to be over 4,000 years old. Perhaps the most interesting exhibit in this section, from an engineering point of view, is that of Mr. Robert W. Blackwell, electric tramway expert, of Queen Victoria street, Westminster. A detailed examination of this exhibit is almost an education in electric traction in itself, everything appertaining to this branch of electrical engineering being shown.

Among trolley wire exhibits is the wire of dumb-bell section, which can be erected without the use of solder, the top part of the wire being mechanically gripped at the pole. It also ensures a uniform path for the trolley wheel, an important point at high speeds when a sudden increase of cross-section may be enough to bounce the wheel off the wire. In this case the pole springs up into a nearly vertical position, and unless the car is stopped in time may strike and damage a span wire.

"Aetna" insulators of the peculiar chocolate color, spangled with mica particles, get a good show. This hydraulically-molded composition has evidently come to stay, and, if the pottery makers do not mind, may encroach on the domain of the porcelain insulator, over which it has the advantage, in that its color does not provide such an inviting target to the small boy, and if hit with a stone does not fly to pieces like pot. The composition gives the appearance of becoming slightly plastic under very hot climatic conditions, but such is not the case; and the writer had the pleasure of recommending their use in the overhead line work for the electric lighting of Coolgardie, West Australia, which at certain seasons is one of the hottest places on earth.

Among the rail material is the well-known Chicago rail bond, consisting of a copper rod slightly longer than the fishplate, with thickened ends which are inserted into holes in the webs of the rails and then expanded by driving in conical drift-pins. The Daniels modification, which enables the expanding drift-pin to be driven into position from the outside of the rail, does not require the removal of the pavement on both sides of the rail.

The Edison-Brown plastic alloy bond, which Mr. Baylor brought to the notice of tramway engineers in this country in his recent paper before the Institute of Electrical Engineers, is also shown. In this bond a plastic metallic composition is inserted between the rails and the fishplate, and is held in place by being surrounded with a cork frame or case, which is squeezed up by the bolts. It is claimed that such a bond on a nine-inch rail will carry 1,500 amperes with a fall of but .03 volt. The plastic compound is packed in small wooden boxes, holding the exact amount required for a joint. One platelayer cleans the contacts, another amalgamates them and slips the bond into place, while a third tightens up the bolts. These bonds are at present on their trial, but it has been decided to employ both forms of bonding on the extensions at Dublin. This plastic material is being used in America for making ordinary switchboard and other connections with excellent results.

Several of the latest types of electric tramway trucks, with motors and gear complete, are exhibited, the General Electric company and Westinghouse motors being shown side by side. The trucks of the Peckham cantilever machine-made type, which has had a large sale in America, are also shown. Among them are the "extra long" type, capable of supporting 35 foot car bodies on an extraordinarily short wheel base, and also the new swivel or bogie trucks, which run two to a car as in large steam trams, and which are now on trial in this country. The space between the axles is such that it is possible to mount two motors without difficulty, and the springs and fastenings are so arranged that with the body packed up the truck frames can be run out for examination of the motors, etc. Dust-tight self-lubricating journal boxes with coil springs are used throughout, in which either oil or grease may be used. Ten to one lever brakes with positive pull-back coil springs to release the brake shoes are fitted, and also lifeguards consisting of a rectangular frame of pipes carrying a netting.

Messrs. Parsons & Co. exhibit a 32 kilowatt continous current dynamo coupled direct to the improved steam-blast turbine, which is complete with jet condenser. The speed for 135 volts is 4,000 revolutions per minute, the air pumps of the jet condenser being worked by means of a worm-wheel of 32 teeth worked by a single-thread screw on the turbine spindle; consequently, the air pump takes one stroke in every 32 revolutions of the machine. Oiling is automatic by means of an oil pump worked from the same worm-wheel as the air pump, the oil being forced up underneath the bearings, and as it is used over and over again there is very little waste. The total weight of this plant is about 3½ tons. Steam is admitted to the turbine in gusts by means of a double-beat valve worked by a steam relay piston, the duration of the gust being controlled by an electrical governor, which is so quick in its action that the whole load can be suddenly switched off or on with only a momentary variation of the volts. Owing to there being no parts in contact in the turbine proper, and consequently no wear, the steam consumption does not increase after several years' running, as is the case with ordinary reciprocating engines, and also, as no lubrication is necessary, the condensed steam can be passed straight back into the boilers.

One London company has now 11 350 kilowatt turbo-alternators in two of its stations. The alternators are four-pole, with the armature coils wound in tunnels on the armature core, and the speed is 3,000 revolutions per minute. They work perfectly in parallel with other types of alternators running at much lower speeds, and the steam consumption is 38 pounds per kilowatt when non-condensing, but a consumption as low as 14 pounds per indicated horse power has been obtained on a condensing steam turbine of 200 horse power.

Messrs. W. T. Glover & Co., Salford, exhibit their patent diatrine cables and twisted wire armature bars with solid ends burnt or melted on. They also show samples of reostene, a new resistance metal having a specific resistance 44 times higher than that of copper. Tramway cables, similar to those supplied to Leeds, are another feature of this interesting and up-to-date exhibit.

Messrs. Fielding and Platt of Gloucester show a five horse power oil engine, and also a very massive 75 horse power gas engine specially designed for driving dynamos direct. The engine takes its explosion every time whatever the load, the governing being effected by a sensitive high-speed ball governor, which controls the gas and air inlets. It might be mentioned, in passing, that 60 horse power and 120 horse power two-cylinder gas engines, driving eight and ten-pole dynamos direct, are used for part of the public lighting of Brussels.

J. C. and J. Field, Limited, of Lambeth, one of the very oldest firms in London, show Galician ozokerit, which is so extensively used by the Brush company and several other firms for insulating and waterproofing, especially for transformers.

Some dynamos made by the Society Hydraulic and Electric of Charlerois for the Belgian government are shown coupled directly to Carel's high-speed inclosed engines, something like the Belliss engine in appearance. The Society Gramme of Paris shows the two largest dynamos in the exhibition, and dynamos are also shown by Jaspar of Liège.

All the multipolar machines have parallel-wound armatures, that is, with as many sets of brushes as poles, and the calm way in which these machines are turned out abroad, all with parallel winding, leads one to the belief that the warning Mr. Swinburne delivered in Industries some years ago, that such winding would give trouble if the armature was to get out of center from wear of bearings or other cause, was a mare's nest after all. Two electric locomotives, one suitable for mining work, are shown, besides motors coupled to pumps and fans.

Messrs. Ganz & Co.'s exhibit is too extensive and weighty for it to be in the Hungarian gallery, so it is separated in one corner of the machinery hall. They show several types of inductor alternator and transformers for both single and multiphase high-tension currents, and a line of three-phase 300 volt motors, ranging from one horse power to 100 horse power, a three horse power machine for working an electric lift being complete with its reversing apparatus, and another motor coupled to a hydro-extractor. There are also several synchronous and asynchronous monophase 100 volt motors of one-half horse power to 25 horse power. Messrs. Ganz appear to be taking up traction work in a thorough manner, and have on exhibition a four-pole 500 volt series-wound tramway motor; a magnetic blow-out controller like the Thomson-Houston, but with two or three slight improvements; and a new type controller, built in the plate or panel form; also lightning arresters, magnetic cut-outs, etc. A Blathy automatic rheostat, a 5,000 volt condenser and a portable electric milling machine for trimming plate edges are interesting. This firm goes in for very heavy engineering work, and a pyramid of railway wheels, a 160 horse power Gerard horizontal turbine and a 320 horse power vertical turbine is imposing. The finish and strength of parts are more like British work than is the case with other Continental manufacturers, and the windings on the electric machines is especially noticeable for neatness.

This exhibition differs from all others in being divided into two distinct parts, which are about six miles apart. The more remote portion is in the very beautiful park of Tervueren, and is approached by what will eventually be one of the finest avenues in the world. The making of this avenue, together with its electric tramway service and arc lighting, has been part of the exhibition scheme, and one in which the king has interested himself very much. It cuts right through a portion of the forests of Soignes, the natural beauties of which are well worth the journey to see. At night, when the 300 odd arc lamps are lighted, the view from Tervueren and in the forests is magnificent. One cannot help contrasting the lighting of this avenue (through six miles of absolutely open country) with the lighting of, say, the Thames Embankment. The arc lamps are suspended on very high lattice poles.

The electric tramway service has only been in operation a few months, and it has been put down by a separate company to the one that runs the trams in Brussels proper. The generating station is situated at Auderghene, on the way to Tervueren, and the principal point of difference to the Brussels tramway being the narrower gauge and the adoption of the Dickenson swinging trolley pole, as used on the South Staffordshire line. It is made of a tapered steel tube about 20 feet long. One very significant feature of the Continental tramways is the almost universal adoption of the Thomson-Houston car equipment—i. e., magnetic blow-out controllers and G E 800 motors. The Elektricitäts Gesellschaft of Berlin, which represents the Thomson-Houston company on the Continent, will no doubt soon manufacture these details, as they are now doing the dynamos; but for the present they appear to be content to import from America.

The arc lighting at Tervueren has been carried out by M. Fabius Henrion of Nancy, and consists of 150 10 ampere arc lamps arranged five in series on a 240 volt circuit; the carbons are 11 millimeters solid and 16 millimeters soft core. All the wire is overhead, a good deal of bar iron being used. The lamps are lowered for retrimming

A somewhat novel form of switchback has been fitted up by M. Henrion, and which, like all such harmless contrivances, appears to be coining money. The rails are arranged round and round in the form of a spiral, finishing up with a run through an underground tunnel. In order to save passengers the trouble of ascending a number of steps to get into the cars, they simply walk in on the ground level, and are raised up a 30-degree incline to about 25 feet high by an endless chain driven by a 10 horse power electric motor.

The Behr monorail or lightning express railway at Tervueren constitutes one of the most distinct novelties of the exhibition on account of the high speed at which the carriage will travel and also because the propelling agency is electricity. The track is constructed on the Lartigue system, with which Mr. Behr, the designer, has had considerable experience at Killarney and elsewhere. It is extra strongly built to withstand the extreme stresses, and is about three miles long, consisting of two straight sections joined at the ends by curves of 1,600 feet radius.

The carriage, made by the Gloucester Carriage and Wagon company, Limited, is 59 feet long, and specially constructed with an air brake, so the resistance of the air in front of the carriage is utilized for reducing speed when required. The lower part of the carriage consists of two bogies connected together by a flexible joint, and they carry the main and guide wheels and the electric motors. The upper part of the body has seats for 100 persons, and two compartments for the driver and conductor at either end. Each bogie carries 16 horizontal guide wheels, or 32 altogether, their object being to maintain equilibrium and transmit to the guide rails the pressure produced by centrifugal force in rounding curves.

The line itself is very solidly constructed of steel, so as to easily resist any pressure which may be produced, and it is chiefly the construction of the line in its relation to the guide wheels and the carriage generally which enables the train to travel at very high rates of speed without danger of derailment, or the accidents liable to happen under similar circumstances on ordinary double-rail track.

The carriage weighs 50 tons, or half a ton of dead weight per passenger, and the centrifugal force exerted at the curve at 100 miles an hour is about 18 tons. In order to reduce the starting effort as much as possible, roller bearings are used, the axle boxes being supplied by the Roller Bearings company, Limited, of Westminster.

The electricity is supplied to the motors from an electrical generating station furnishing about 1,000 horse power, erected in the machinery hall at Tervueren. This electric station consists of six four-pole dynamos by Dulait & Co. of Charlerois, each giving 750 volts and 130 amperes. In this matter of power, Mr. Behr has been somewhat unfortunate in his relations with the exhibition authorities, as it appears he was to have been provided with

1. From the Electrical Engineer, London.

current at a very much earlier date than he actually did get it. Fortunately, he was able to get current for the recent visit of the lord mayor, but since then there have been several stoppages of the generating plant.

The motive power on the train is supplied by four series-wound motors of the four-pole type, having toothed armatures wound with Eickemeyer coils. Each motor is capable of working up to 150 brake horse power when supplied with current at an electromotive force of 700 volts and running at a speed of 600 revolutions per minute. It transmits energy to the wheels by means of two Renold patent steel chains from pinions geared on each end of armature shaft. The chain wheels are of hematite iron, and are flanged, and have 32 machine-cut teeth. The pitch is 1¼ inches and the outside diameter 12¾ inches, which gives a chain speed of 2,000 feet per minute. The chain is of the laminated or silent type which was recently introduced by Mr. Renold, and which gives an even load distribution over all the teeth in the circumference clasped by the chain. Each chain is four inches wide, there being one to each of the four motors and axles. The gear is level—that is, both the motor and the axle run at 600 revolutions, but the chain is necessary in order to get the motor low down and to allow for the movement on the springs of the carriage. The motors are controlled by a set of switch-gear fixed in the driver's box. At starting, the four motors are connected in two parallel groups, with a resistance in series with them. This resistance is gradually cut out, and the connections are then changed, so that all four motors are connected in parallel with the resistance in series. This latter is then cut out, so that the four motors in parallel then become connected directly across the full electromotive force. To attain a still higher speed, the series field winding of the motors is shunted through the resistances. A double-pole automatic magnetic cut-out is fixed above the controlling switch, and circuit is made and broken entirely by this either automatically in event of too much current being demanded for any reason, or by the man in charge when he wishes to stop the train. A reversing arrangement is provided, so that the train can be run in the reverse direction at a slow speed should it be necessary.

The electrical conductor placed along the line consists of a steel rail of channel section, 4½ inches by two inches, supported on china insulators attached to the steel sleepers. Rotating wheels running along this rail pick up the current as the train moves, the return circuit being made through the wheels and ordinary rails.

The government invited Mr. Behr to construct the experimental line at Tervueren, with a view, if it was successful, of adopting such a system from Antwerp to Brussels. The designer estimates that the cost of constructing such a line, including rolling stock, electrical generating station, and everything complete (exclusive of land), would be about £9,000 per mile; and the tests have shown that the working expenses would be much less than with ordinary double-rail track wherever a large and regular passenger service is assured. This is distinctly the case with Antwerp and Brussels, which are almost analogous to Glasgow and Edinburg; and if reasonable fares could be charged, there is not the slightest doubt that Brussels would benefit largely by such a line.

Owing to the temporary character of the line at Tervueren, and the two curves in so short a length, the trials are being carried out under more difficult circumstances than would be met with on such a trunk line as is proposed. The difficulty of finding suitable ground has been so great that it became necessary to construct an embankment 18 feet high, besides a deep cutting, in order to obtain possible working gradients. The starting point had to be placed in the middle of the curve instead of on the straight, and the curves are very much sharper than would be employed in actual practice. The transition curves between the principal curves and the straight line could not be made of the length required, for the simple reason that if they had been the four transition curves alone would have absorbed the whole length of the line. From the above it will be seen that the conditions are extreme ones, and if Mr. Behr can get his train to run at 70 to 80 miles an hour on such a line, there is not the least doubt that he could safely travel at a 50 per cent. greater speed on a properly constructed line.

The first time the train was run round it attained a speed of over 70 miles an hour, and the side strain due to centrifugal force was sufficient to alter the angle of the rails on the embankment from four degrees to 11½ degrees. This was a good deal due to the loose, sandy soil of the embankment, but it shows how valuable the experiments which are now being conducted at Tervueren are to those interested, and which will form the basis of the future high-speed lines which we are bound to have before many more years are past.

It is a satisfaction to know that Mr. Behr is quite convinced that electricity will have to be the power employed. He is undoubtedly on the right track for attaining high rates of travel which, in the entire absence of points, should be quite as safe as 60 miles with steam locomotives and an ordinary four foot 8½ inch track. From a British point of view, a very satisfactory feature in connection with the line is the fact that the motors, controllers, switchboard, etc., were designed and supplied by Messrs. Thomas Parker, Limited, of Wolverhampton. In choosing this firm as the contractors for what may be called the brainy part of the work, the promoters were no doubt largely influenced by the plucky way in which Mr. Parker and his young men (as he affectionately calls the prominent members of his staff) met and successfully carried out the electrical equipment of the Liverpool overhead railway. Before leaving Wolverhampton the motors were exhaustively tested at the speeds and, as far as possible, under the same conditions as they will be under when traveling at 120 miles an hour, and were passed as thoroughly satisfactory. When the car is going at 100 miles an hour, the speed of the motor is 600 revolutions per minute.

Ireland Denied Permission to Develop Water Powers.

[T. M. Healy in the London Times.]

On page 4 of the Times of to-day there is a striking advertisement. It fills the whole page and is in double column. Everyone who sees the paper must be caught by it, even folk who usually do not read advertisements. It is about an American canal. Its authors want half a million of English money. They set out that they have got an act from the state of New York to develop the water power of the St. Lawrence, and the following reason, among others, is given to show that the investment is sound:

"It is estimated that the production of power by steam costs, under favorable circumstances, about £10 per electrical horse power per annum. At Niagara a charge of about $19.11, or, say, £4 per electrical horse power per annum is made, while this company will be able to sell at $12, or, say, £2 10s. per horse power per year. It is considered that the demand for cheap power is so great that the whole of the power this company has to dispose of should be rapidly taken up. It is understood that there are various electro-chemical processes which depend for their success upon being able to obtain very large quantities of power at a low rate."

Just so. But a couple of months since the House of Lords rejected an Irish "Industries bill" which would have allowed water power in waste places in Ireland to be similarly developed. We sought no half million on the Stock Exchange. We only asked from the conqueror permission to develop our humble resources; but the House of Lords, at the instance of its chairman and of the prime minister, unanimously rejected a bill unanimously passed by the Tory House of Commons. Then comes a foreign company to you for £500,000, flourishing an act of the state of New York, and the upholders of the system who reject a bill to enable the "sister island" to compete in the industrial race will doubtless cheerfully subscribe the half million asked for by the Yankees.

By and by Irishmen will be asked by the superior race why they can never do anything for themselves and are unable even to employ the resources which nature showers on their island.

Hence we are a very loyal race, and gladly contribute £8,000,000 annually as a tribute to the blessings we receive from the British constitution.

Engineers for Electrical Boats.

The following has been issued from the office of the secretary of the treasury in relation to the law requiring steam engineers on vessels propelled by electric motors, etc.:

"Under the act of Congress, approved June 18, 1897, 'vessels of above 15 tons burden, carrying freight or passengers for hire, propelled by gas, fluid, naphtha, or electric motors,' were included in all the provisions of section 4,426, R. S. U. S., which requires a licensed engineer and a licensed pilot, the same as is required for steam vessels under said statute. The only qualifications for engineers provided for in Title LII., R. S. U. S., which includes the statute above noted, are to be found in section 4,441 of the same title, and the rules and regulations of the Board of Supervising Inspectors founded thereon; and there is no authority in this department to order a different ruling, as to do so would be contrary to the law and the regulations referred to. This department realizes the difficulties of the situation in regard to 'gas, fluid, naphtha and electric motor' engineers, and will submit the matter to the Board of Supervising Inspectors when it meets in regular session in January next. In the meantime and until the board takes action on the subject, the class of vessels under consideration will have to employ a regularly licensed engineer, such as employed on steam vessels."

Reduction of Telephone Rates in Michigan.

[From the New York Tribune.]

Detroit, Mich., September 3.—The old telephone monopoly in this state, that of the Michigan Bell Telephone company, to-day announced that it felt the competition of the new company by an authorized statement that hereafter the rates for telephones in business houses would be reduced from $72 to $36 a year, and that state connections would be made at 10 cents for five minutes instead of 25 cents, as under the old régime, both to take effect October 1st. Mr. Forbest, manager of the Bell company, admitted that his company had been forced to this step by the competition of its rival, and said that private or house telephone rates would be cut later in the same proportion. He also added that the price of coupon books of message tickets would be reduced 25 per cent. on every $50 purchased.

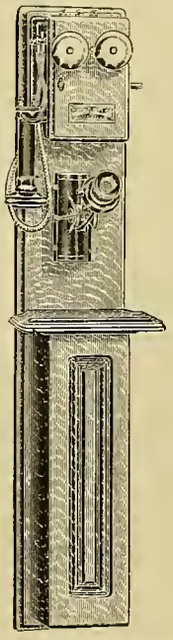
President Holmes of the Detroit Telephone company says that the company will pay no attention to the new rates, as he is satisfied that people will stand by the company which has forced the old monopoly to reduce rates. At no other point in the country will telephoning, after October 1st, be so cheap as in Detroit and the state of Michigan.

Art in Advertising.

To advertise well is an art, surely, and to use effectively works of art for this purpose is thus, in a double sense, "art in advertising." The Western Electric company, in addition to its newspaper work, is calling the attention of its customers to its extensive line of goods by the method of using high-class pictures, clearly printed on heavy cardboard. The first picture is a reproduction of a photograph of Niagara Falls. The second picture is a handsome photo-engraving, 11 by 14 inches, of the famous battle between the Romans and Sabines, about 750 B. C. This picture is aptly named "The Battle of Competition." While the combatant who represents the Western Electric company is not particularly pointed out, an apt quotation from Shakespeare printed under the picture gives the observer enough range of thought to select the one most appropriate. The picture will undoubtedly be preserved by all those fortunate enough to secure a copy.

New Kokomo Telephone.

The line of telephones and telephonic apparatus made by the Kokomo Telephone and Electric Manufacturing company of Kokomo, Ind., is claimed to be of the highest grade. The goods are fully guaranteed, made by skilled workmen from the best of material, and the company says that every exchange which it has equipped stands as a reference. The transmitter is the principal feature. It is said to be a mild microphone, built on the granular carbon principle but on entirely different lines from the Hunning or Berliner. It was patented on November 17, 1896. The manufacturer claims that it is impossible to pack this transmitter, and adds that it does not depend on the constant contact of two electrodes for the variable resistance. The telephone shown by the cut—known as No. 6—is fitted with this long-distance transmitter and also with a 10,000 ohm magneto, an adjustable iron arm, standard hard rubber receiver and two cells of battery. The instrument is elegant in design and finish—a handsome exchange instrument. It is encased in quarter-sawed white oak.



NEW KOKOMO TELEPHONE.

Modern Inventions.

Some idea of the extent to which modern inventions have broadened industry is furnished by the statistics of the various enterprises which depend upon electricity.—Utica Daily Press.

True, and one can hardly find a better illustration of the falsity of the old cry that improved machinery is an injury to labor.

More than two millions of skilled workmen and ordinary artisans get a living out of electricity. There are the telegraph and the telephone, which give constant employment to a large army of laborers. Then the electric light system extends to all parts of the country and demands another army almost equally large.

Electricity may deprive a dozen men of their old-time tasks, but it calls for two dozen to do other tasks, with good wages. There is no use in having a crick in your neck looking at the past and warbling about "the good old days." There never were better days than these, and there never were more contented people than can be seen right here and now.—New York Herald.

Sewage and Drainage Utilized for Power.

About one year since the regents of the Washington Agricultural College and School of Science at Pullman, Wash., offered a prize to the civil engineering department of the school for the best system of waterworks for the college. Plans were presented, entailing a cost of nearly $15,000, but lack of funds prevented any further action. During the winter the knowledge of the offered prize came to two of the mechanical students in the electrical department, and quietly they prepared a complete and original set of plans, making all surveys, etc., without the matter becoming known except among a few of the professors. These plans have just been accepted by the Board of Regents, and the two students, of the class of 1898, have been placed in charge of the construction. The entire plant, including the apparatus in use at the time of the prize offer, will be built for less than $1,700.

In order to describe the installation proposed it will be necessary to indicate the topography of the college grounds. The college buildings are situated on the slope overlooking the town of Pullman, at an elevation of about 200 feet above the town. Back of the buildings and on the summit of the hill is the reservoir, now being supplied by the city pumps. At the foot of the hill is the light and power plant. At a slightly lower elevation than the buildings is the large settling basin and flush tank into which all the college sewers turn their waters. The students conceived the idea of conducting this sewer water from the flush tank to the power plant in a pipe and there utilizing the fall by a Pelton water wheel to drive a power pump taking water from an artesian well in the power house. In order to still further increase the efficiency of the plant, the young men propose to turn the drainage from the roofs of the buildings into the general sewer, thus making the descending rain-water assist in pumping drinking water to the reservoir. Two steam engines are comprised in the present power plant, but are worked under small load. The pump to which the water wheel will be belted is also to be belted to the jack-shaft in the plant. The flushing of water from the tank and the pumping by water wheel are arranged to work automatically, the engines to be used only to make good the losses in supply and to keep the supply even.

The new plant is arranged so that a portion can be constructed and put into service at once, the complete installation awaiting the necessary appropriation. The cost of the part of the plant necessary to give service for this year will not exceed the rent to be paid to the city for the water for one year under the terms offered, while the expense of running will be small, all pumping being done while lights are in use.

The college authorities have also entered into contract whereby they furnish lights for the city. A 500 kilowatt alternating dynamo of the Westinghouse pattern is now en route from the East for this service. The dividend derived by the college from this contract, together with the money saved in pumping water, will represent a saving to the college of about $2,000 per annum.

Telephones in Corry.

In Corry, Pa., there is a Keating exchange which has been in operation about 18 months. It has now about 125 subscribers. It is said that the old exchange, owned by the Bell company, had only about 17 subscribers for several years, until stirred up by lively competition. The warfare is now unrelenting. One incident that has created a local commotion is the refusal of the Pennsylvania Railroad company to put back a Keating instrument in its freight office after taking it out. It is said that 50 of the best business men of Corry, who are connected with the Keating exchange and also have business with the freight house, petitioned the Pennsylvania company to replace the Keating telephone, but to no avail. This refusal is attributed to Bell machinations, although the railroad company, in its letter of refusal, refers to some existing contract and also to its fear of litigation.

Alley "L" Power House.

Workmen are engaged in making the excavation for the power house of the South Side Elevated Railway company of Chicago, to be used in furnishing the electrical power which will shortly replace the steam locomotives. The building will be erected at State and Fortieth streets, where the road turns eastward. The structure will extend 112 by 199 feet on the ground and will be one story high, with a 200 foot stack. It will be built of brick, and will cost, exclusive of machinery, about $65,000.

Telegraph Business and the Klondike.

The Western Union Telegraph company is to string a new wire between San Francisco and Chicago to accommodate increasing business. It will follow the Central and Southern Pacific railroads, and will be completed in about 60 days. One of the principal reasons for the company being anxious to finish this work immediately is the immense amount of matter ordered daily by prominent eastern journals regarding the gold discoveries on the Klondike.

Precision of Electrical Engineering.[1]

By Francis B. Crocker.

Part I.

There still exists quite a general idea that electricity is so imperfectly understood that its laws and actions are little more than matters of chance or guesswork. The experience of the electrical engineer is supposed to consist of a series of surprises and shocks to his mind as well as to his body. This notion is not confined to the ignorant, but is believed by many educated persons, even including our brother civil and mechanical engineers; indeed, some members of our own profession hear this opinion expressed so often that they partly accept it as true, or at least they have no ready arguments with which to refute it.

The existence of this popular error concerning electricity is perfectly natural, and arises from the novelty of the subject and the fact that its development has been so great and so rapid that no one but a few specialists have been able to keep pace with it.

The subtlety, extreme rapidity of action and the astonishing achievements of this modern agency make it appear most mysterious and occult in comparison with the ordinary forms of energy, such as heat and mechanical power. Possessing such transcendental powers, it is looked upon as something not only unknown but unknowable—an irresponsible power for great good or great evil. This idea has sometimes been the cause of actual harm to the progress of electrical engineering. The profession has been considered to be hardly legitimate, those who practiced it being regarded as either wizards or charlatans, or a combination of the two. During the present year the president of a large steam railroad system on which electric propulsion is being tried publicly expressed his opinion that electrical engineers know little or nothing of their subject. In legal decisions in this country and abroad, judges have stated that electricity was so vaguely understood that testimony concerning it was of no practical value.

It has also been held by many courts that electricity, being intangible, has no real existence, so that the tapping of current from the wires could hardly be considered as a theft, except in an imaginary sort of a way. The production of electrical energy in central stations has been decided by metaphysically inclined judges to be a totally different kind of business from the manufacture of gas. In point of fact, the differences are all in favor of the practical character of electricity. More useful operations can be performed by it; it can be more easily transmitted and distributed; the percentage of leakage is less, and its measurement is far more convenient and accurate.

The idea that "no one knows what electricity is, therefore we know practically nothing about it," is often expressed by those who want to excuse their own ignorance of the subject. They are glad to think that they are no worse off in this respect than the rest of the world. Their deduction is quite natural, but is absolutely fallacious. While we must admit that we do not know the real nature of electricity, the same limitation of knowledge applies to all other fundamental facts. Gravitation is the most familiar of natural phenomena, yet we have no conception whatever of what it actually is. Our theories and mental pictures of the nature of electricity are much more definite than those concerning gravitation. In regard to the latter, little progress has been made since the time of Newton, while electrical knowledge has advanced and is now advancing with giant strides. There is every reason to believe that we shall "know what electricity is," and be able to explain the inherent mechanism by which electrical actions take place, before we understand how and why a stone is drawn to the earth. What we do know, however, are the laws of both electricity and gravitation, as well as the results that they produce, and it is very doubtful if our ability to control, measure and utilize these agencies would be improved even if we understood their exact nature. The laws and applications of hydraulics would be just as definite and successful even though the fact were not known that water is composed of two atoms of hydrogen and one of oxygen. It is possible that methods of generating electricity may be advanced when its real character is discovered, but it is not likely that this knowledge will greatly affect the methods of handling and using it.

The popular ignorance and doubt concerning electricity are rapidly disappearing in consequence of the remarkable results accomplished by it during the last 10 or 15 years, but it will not be out of place, I think, to consider at this time the remarkable exactness which electrical engineering has reached. A discussion of this question may serve to inform laymen who are not familiar with the facts, and may also be a matter of interest and satisfaction to ourselves. This profession has only very recently gained for itself a position of independence and equality among the branches of engineering, but it can now fairly claim to be an example for the others to follow, not only in the magnitude and rapidity of its results, but also in the exactness and certainty of its methods. Let us consider what are the principal facts upon which this strong claim is based.

The names connected with electrical science—Gilbert, Franklin, Faraday, Ampere, Maxwell, Henry, Helmholtz, Kelvin, and a long list of other distinguished electricians—are not those of men whose ideas are vague or incorrect. Indeed, it is a significant fact that the ablest and most profound scientific men have been attracted by, and have performed some of their best work in, the study of electricity.

The rapid progress of electrical science and its applications is an absolute proof of sure and exact knowledge. Uncertainty would necessarily cause delay, and error would involve repeated trials before success could be reached. The fact that the difficult arts of long-distance transmission of power and electric traction have been developed to their present state of importance and success in about 10 years shows conclusively that electrical theories and designs agree very closely with the actual facts.

The great results accomplished by electrical engineering are probably its strongest claim. Many of these are so unique and astonishing that we still regard them with wonder even after we have become familiar with them. Among the most striking of these examples are the locating of faults on submarine cables, telephoning a thousand miles or more, transmitting power over 100 miles, sending simultaneously a number of messages on the same wire, utilizing the power of Niagara and producing the Röntgen ray. These and hundreds of other wonderful feats are not accomplished by chance, or by groping in the dark.

The close relationship between pure and applied electrical science is still another proof of the exactness and truth of both. If knowledge were complete, theory and practice would become identical. The agreement between theoretical and practical electricity is largely due to the small losses which occur in electrical apparatus and processes. Even quantities which correspond to friction in mechanics, such as electrical resistance and magnetic hysteresis, are capable of exact calculation. It is only the purely non-electrical factors, such as the friction of bearings and air resistance, that are uncertain in designing electrical machinery. The almost infinite rapidity of electrical action makes the time element so small that it can almost always be neglected. This greatly simplifies calculations and renders their results more accurate. The fact that there is only one kind or quality of electricity also gives definiteness to our ideas and calculations. With coal we must know its quality, including both its physical and chemical properties, in order to make even approximate calculations concerning it. In the case of steam, pressure and volume are not sufficient data; the amount of moisture or superheating must also be known. The most accurate methods of the physicist are not any too good nor beyond the reach of the electrical engineer, and they are often employed by him. A notable example of this is Lord Kelvin's work in connection with laying the Atlantic cable, which was undertaken at about the same time that he began to publish his essays on the vortex theory of matter. When Werner Siemens first built his self-exciting dynamos, he also constructed the sensitive galvanometers used in the researches of his friend Helmholtz. It was Siemens, the electrical engineer, who gave his money and influence to the Reichsanstalt, an institution where the most accurate physical work is now being carried on.

A historical example of the agreement between electrical theory and fact is the brilliant work of Ampere, who gave to the world a beautiful and complete theory of electro-magnetism within a few days after he heard of its discovery by Oersted. The work of Maxwell is another great example of the power of the intellect to deal with electrical problems.

Hertz said, in regard to Maxwell's electro-magnetic theory of light: "It is impossible to study this wonderful theory without feeling as if the mathematical equations had an independent life and an intelligence of their own; as if they were wiser than ourselves, indeed, wiser than their discoverer; as if they gave forth more than he had put into them. And this is not altogether impossible; it may happen when the equations prove to be more correct than their discoverer could with certainty have known."

It can hardly be admitted that there is anything in Maxwell's equations that he did not put into them, but the remarkable experimental corroboration of Maxwell's theories, many years after they were evolved, shows that from a few fundamental truths almost the whole theory of electricity may be deduced.

This power to solve problems successfully by a priori reasoning demonstrates the perfection of electrical science. We can arrive at the facts by reasoning out what they ought to be; hence we may say that electrical science is ideal. In other branches of applied science, as for example, in civil engineering, the corrections, factors of safety and other allowances are often much greater than the original quantity itself. In such cases it is obviously impossible to go very far from an experimental fact by any process of reasoning. The errors would immediately become so magnified that the truth would be greatly distorted or lost entirely.

To take a concrete example, the losses in transforming electrical energy are only two or three per cent., and if an error of 10 per cent. is made in calculating these losses, the actual error is only two or three-tenths of one per cent. It would, therefore, be possible to design a system in which electrical energy was transformed many times, and yet the final error would only be one or two per

1. Inaugural address of the president, at the fourteenth general meeting of the American Institute of Electrical Engineers, Eliot, Me., July 26, 1897.

cent. If, on the other hand, the losses in mechanical engineering are 10 to 20 per cent., or even 50 per cent., as is often the case, an error of 10 per cent. in calculating these quantities would soon become multiplied to a large figure.

Exactness in electrical units and terms is another strong point of electrical engineering, because definiteness in terms and ideas go hand in hand. The system of electrical units is complete and scientific, being based directly upon the C. G. S. system, and is the only example of a set of units which are universally adopted. The metric system is not in use in the United States, England and her possessions and many other countries, but the same electrical units are accepted by all nations. This avoids the great confusion which arises from the use of several different units for the same thing, as is the case in steam engineering, in which at least four different heat units are commonly employed.

In electrical engineering the distinction between the various quantities is usually more clearly understood, as, for example, the difference between force, work and power. In other branches these quantities were often confused, and the fact that mistakes of this kind are not more often made at present is largely due to the influence of electrical engineering in the accurate use of terms. The useful word torque has been introduced through electrical engineering, although it is a purely mechanical quantity. The adoption of such terms as impedance and reactance gives a nicety of expression which is rarely found in other applied sciences.

The facility and accuracy of electrical measurements contributes greatly to the precision of electrical engineering. Volts and amperes can be easily, quickly and accurately measured by means of convenient portable instruments. The products of these volts and amperes gives the watts or power which is the most important quantity.

If desired, a single instrument, the wattmeter, can be used to combine the two quantities. Electrical resistance can also be measured easily and quickly, and with still greater accuracy. Even the less common electrical quantities, such as capacity and inductance, can be measured without much difficulty and with reasonable exactness. The magnetic quantities are also quite easily and correctly determined. As already stated, the most doubtful factors in electrical engineering are the mechanical ones.

The enormous range in electrical engineering is still another proof of its precision. The same laws and principles which apply to the almost infinitesimal galvanometer current are equally applicable to the current from an electric light station. The former may be only a hundred billionth of an ampere and the latter reaches ten thousand amperes, which is a thousand million million (10^{15}) times greater.

An even greater ratio than this represents the range of resistance measurements. In the case of large copper bars, a determination to within .000001 ohm is often required, and for insulation testing 10,000 megohms is not an unusually high figure. This gives a range of measurement of ten thousand million million (10^{16}).

An electrical instrument, the bolometer of Professor Langley, is used to measure the heat received from the fixed stars, and electricity is also the agent selected when 100,000 horse power are to be distributed from Niagara. Instead of saying that electricity is selected for these extreme uses, it would be more correct to state that it must be employed, just as it is the only means of transmitting speech a thousand miles, or performing the many other miracles of which it alone is capable.

The directness and high efficiency with which electrical energy can be converted into other forms are other facts which give exactness to our work. It can be transformed into heat, light, magnetic, mechanical or chemical energy, by the simplest means, and, conversely, the latter forms, with the possible exception of light, can be readily changed into electrical energy. In most cases the conversion is almost perfect, the efficiency of an electric motor or dynamo being usually over 90 per cent. and often 93 or 94 per cent. The chemical energy in a storage battery represents nearly 90 per cent. of the watt-hours applied to it, assuming the losses in charging and discharging to be about equal. The storage of magnetic energy may be effected at an even higher efficiency of 97 or 98 per cent., and the conversion of electrical energy into heat is complete, the efficiency of an electric stove actually reaching the ideal figure of 100 per cent. The production of light cannot be accomplished so economically, nevertheless the arc lamp has a far higher efficiency than any other source of artificial light, although it is usually stated to be only eight or 10 per cent. It is also more than probable that the long-sought-for high-efficiency lamp will be an electric one when it is finally invented. This facility and economy of transformation puts electricity directly in touch with the other sciences and their applications, avoiding the chances for error which roundabout processes necessarily involve. None of the other forms of energy possesses anything like the same convertibility. The one serious difficulty in connection with electricity is the fact that its generation requires a boiler, engine and dynamo, bringing in heat and mechanical power as steps in the process. If this complication could be avoided, and electrical energy produced directly from the chemical energy of the coal, the only limitation would be removed. This has already been done in an experimental way, and by the substitution of water power for steam, one piece of apparatus and one form of energy are eliminated, but the complete independence of electrical engineering and the realization of all of its possibilities will be secured when the direct conversion of fuel energy into electrical energy is accomplished practically.

It has been shown that there are no less than eight substantial grounds upon which the precision of electrical engineering is based. The consideration of these has incidentally brought out several concrete examples, but it will be well to cite a few other special instances which demonstrate electrical exactness.

The one which first claims our attention, not only on account of its historical precedence, but also from its wonder-compelling results, is the locating of faults in ocean cables. In this connection I quote from information kindly furnished me by one of the vice-presidents of the Institute, A. E. Kennelly, who has had a long and successful experience in this branch of the profession. He states that, "In the case of cable coiled in a tank and which has been taken into the tank over a measuring drum without being subjected to any considerable tension, the precision with which a fault in the gutta percha can be located is sometimes very considerable. I have known one or two cases in which a fault has occurred in a length, of, say, 30 miles of cable immersed in water and maintained at practically one temperature in the tank, and in which, by means of the Varley loop test repeated many times and under various conditions to eliminate constant errors, the electrical position of the fault has been determined to within a probable error, representing about 20 feet of length. On turning the cable over from one tank to another by a seven foot drum on which the cable makes three turns, and cutting the cable when the computed distance has been run over, the fault has been found on the drum, that is, in the 60 feet or so of cable then lying on the drum."

"As regards the location of faults in submarine cables on the ocean bed, the precision depends upon a variety of circumstances, and in general is necessarily much lower than in the case of a cable coiled in a tank. The average error in practice, or the difference between the true electrical and computed positions, is perhaps about 15 ohms, or about 1½ miles of cable having the common resistance of 10 ohms per mile. Under favorable circumstances a complete break in a cable developing a fair extent of surface exposure to the sea water at the end of the copper conductor, the electrical position can be determined within five ohms in a total conductor resistance of 1,000 ohms. In the case of a fault in the insulator, sufficiently serious to interfere with signaling, specially favorable cases will occur in which the electrical position of the fault can be determined to within one ohm when a loop test is obtainable and when the total conductor resistance of the loop does not exceed 3,000 ohms." "I have known a case of total loss of continuity in the conductor, accompanied by perfect insulation. It occurred in lifting a cable for repairs and was within half a mile of the ship. A measurement of electrostatic capacity enabled the distance to be determined within a few yards." Other cases are given by Mr. Kennelly, and many may be found in various works and journals, but these are sufficient to show the astonishing results that are possible, as well as those that are obtained in regular practice.

The methods employed in locating faults in underground conductors are quite similar to those used for submarine cables, but the results are less striking and important. William Maver, Jr., who is an authority on this subject, cites a case in which the calculated position of a fault was 2,343 feet from the testing end of an underground cable 4,200 feet long. The defect was found at the exact point indicated. The alternative would have been the tearing up of the street and cutting through a heavy iron pipe until the fault was found, as the conduit was not provided with manholes. One way to locate a ground connection, which illustrates the simplicity and certainty of electrical testing, consists in sending a current through the conductor to the ground through the fault in the insulation. A compass carried along over the cable will indicate by its deflection or non-deflection when the fault is reached. The facility of overcoming distances and obstacles impassable to other agencies is characteristic of electricity and magnetism.

The writer has had occasion to test the resistance and position of faults ("grounds") on a very large system of underground conductors for electric lighting. Although the problem was complicated by the fact that it was a three-wire system which extended several miles, it was found possible to determine the insulation resistance of each of the three conductors. The position of a "ground" is shown by the potential difference between the conductor and the earth, being a minimum at that point. For example, if a ground connection exists on the positive wire and a considerable current flows through it into the earth, the potential of the earth at that point will be raised above its normal value. The potential difference existing between the wire and the earth is actually less near the ground connection. This may be measured from the station by using the "pressure wires" ordinarily laid with the feeders and special wires which connect to the ground at various points of the system.

W. H. Patton will give his motor-car a 60 day trial at Cedar Falls, Ia.

Electricity in the Air.[1]

By E. B. Dunn.

It is a scientific fact that the atmosphere contains more or less electricity at all times. Over a century ago Benjamin Franklin gave a practical demonstration of this truth by drawing a current of electricity from the upper atmosphere through a kite. Other experiments of a similar nature resulted in the death of several experimenters, they having unwisely lost sight of the fact that it was necessary to have some protection in the shape of insulation in case of an overcharge.

These experiments have proved beyond doubt that electricity may be drawn from the atmosphere by simple means, all of which have been long understood and are quite natural; moreover, we know that it is easier to obtain this current under some atmospheric conditions than others. Dry air is a non-conductor and moist air a good conductor of this valuable invisible power, and the greatest amount of electricity is found when the atmosphere is charged to its full capacity with moisture.

Electricity is shown in the phenomena of thunderstorms, in the slight electrification in the air during clear weather, and in the aurora.

During the auroral display it has been possible, owing to the abundance of electricity in the air, to work telegraph lines and transmit messages for long distances without the aid of a battery. The most plausible theory of the aurora is that of Franklin, that it is caused by electric discharges in the upper air, resulting from differing electrical conditions of the cold air of the polar regions and the warmer streams of air and vapor raised from the ocean by evaporation in tropical regions.

It is generally understood that the clear air above the earth is positively electrified, and that the air at the earth's surface is negatively electrified and its volume measured by its potential from a point above the earth to that at the surface, while the air between the upper and lower layers serves to keep the opposite charges separate.

It is usually found that in cloudy or rainy weather the charge is of a negative character, and with clearing weather it changes to positive, any definite change in the electrical conditions indicating a change of weather conditions.

Atmospheric conditions must necessarily play a very essential part in the electrical potential. This being so uncertain and weather conditions so changeable, it may never be possible to obtain a constant for any given elevation; but it is possible to so govern the current drawn from the clouds or a clear sky, by passing it to earth through lightning arresters or possibly resistance coils, that by the time it reaches the desired point its potential would be so reduced as to allow its charge to be utilized in charging storage batteries.

Now, it may be said that under the most adverse conditions the current would be found too weak to be of value; but I believe that even under such conditions there would be sufficient electricity gathered to continue in force that previously stored without failure or loss of power, provided the capacity of storing is sufficient to meet the wants of an emergency of this character.

This would provide against the unstable atmospheric element, and the periods and conditions under which its greatest volume exists being known, extra precaution and provision must be made for storing for future use.

It is contended by some that the ocean affords the best facilities for gathering and storing this valuable power. I contend that, although the ocean may be the better conductor, it would be more difficult to store on the ocean than on land, for it is always an easy matter to carry a current to moist soil and there do the storing. Besides, there is in addition to be gathered the earth currents and that artificially generated by the thousands of dynamos, etc., which is of itself to-day a vast power and is hardly utilized before the power is lost. There is nothing to prove that a current when once set in motion cannot be controlled and made a permanent power; its force, if stored, may be used over and over again, if a proper conductor is provided, after it has performed its work, to carry it to a reservoir or storage plant for future use.

Have you ever thought of the great volume of electricity which our atmosphere contains? We inhale with every breath a sufficient quantity to strengthen and invigorate us—it is one of the most important elements. There is an ebb and flood wave to our atmosphere which is similar in its action to the tides of the ocean. Its maximum pressure occurs at certain hours of the day and night, and its minimum at opposite hours. When the pressure is at its minimum the electrical force of our bodies is least, and at such times we are greatly enervated and weakened, and at periods of excessive humidity similar effects in our physical condition may be observed. When the atmosphere is thoroughly saturated it is a more perfect conductor, and the current readily leaves us for that offering the least resistance. All these forces tend to show and prove that there is an electrical discharge from one substance to another, and fully demonstrates that it needs but the best conductor to gather and a proper receptacle to store the electric fluid which constantly surrounds us.

Several experimenters are already employed in

1. From the North American Review.

devising a plan for gathering and storing atmospheric electricity, and I am confident from the progress already attained in this line that it will not be many years before atmospheric electricity can be properly stored and utilized, taking the place of all lighting, heating and motor power employed at the present day.

The possibilities and uses to which this power may be applied are innumerable. I expect to see it used in every house in as simple a manner as gas or water, so that it shall be within the reach of the poor as well as the wealthy.

The earth and atmosphere were given to men, mice and bugs for useful purposes; the earth has responded to many of their wants, and now, as science progresses and we are becoming more enlightened, the possibilities of atmospheric qualities and quantities are open for experiment.

Suggestions for Electrical Exporters.

[From the Journal of Commerce, New York.]

The opportunities offered to the manufacturers of the various electrical appliances to increase their export trade have been quite encouraging for the past few months. In fact, the exportation of electrical machinery, material and appliances is to-day as heavy as any other class of manufactured articles shipped from this port. A glance at the outward manifests published daily by the Journal of Commerce and Commercial Bulletin will verify this statement and show that there is hardly a steamer leaving New York that has not a good quantity of electrical goods on board. Electrical material for export, however, is one of the most difficult classes of merchandise to trace, on account of the various ways in which it is shipped and manifested. Dynamos, motors and other heavy pieces are invariably shipped as machinery without being classified. Electrical fixtures made of brass or iron often go as hardware, and any quantity of material made of glass is shipped as glassware. According to the export representative of one of the leading local electrical companies, the only materials that usually have the proper classification are sockets, wire, incandescent lamps, telephone and telegraph material and general station supplies. More care is taken on the classification of electrical goods going to Central and South America and the West Indies than to Europe. The reason for this is that in many of those Spanish republics a heavy fine is imposed unless the material is properly classified, while for Europe not so much care is taken. The shipments of telephone material to Mexico have been unusually heavy during June. Between two exporters upward of $25,000 in value has been sent. To Venezuela some good orders for the same kind of goods are at present being placed by a Broad street firm, which has just closed a contract for lines of some length. There are also a number of inquiries in the market for several telephone lines in Central America. Colombia and Guatemala are said to be the best markets in that country. The European market is at present the best for electrical equipment and machinery. The export representative of the Walker company, when questioned on the subject, said that in the majority of cases all the European business was transacted direct. When an exporter is interested in the transaction it was only in the way of attending to the shipment and making payment. From the Argentine Republic there is considerable business anticipated in the way of electrical roads, but it is the general opinion that a good share of the transactions may come through European bankers. In comparison to the amount of export trade transacted in the electrical business there are but a few firms catering to that trade through local exporters. Since E. S. Greeley & Co. went out of existence only one large concern remains that caters generally to the electrical sundries in telephone and telegraph material for export; that is J. H. Bunnell & Co. Concerns like the Westinghouse Electric and Manufacturing company, Walker company, General Electric company and Western Electric company have their own specialties and do not, as a usual thing, execute orders for goods other than their own manufacture. This is the reason why, in the opinion of certain export merchants, there is a comparatively good field awaiting certain classes of electrical goods manufacturers to increase their export trade.

Electricity in Warfare.

The recent attack on the British camp on the Malakand, has once more emphasized the necessity for such isolated military posts being protected by electric searchlights. A London correspondent says that had there been a searchlight available on this occasion, its use might, perhaps, have averted an attack. It would certainly have enabled the defenders of the position to give a better account of the enemy. The extended application of the use of electricity in Indian warfare has been urged, and attention has been drawn to the fact that during the Chitral campaign the bursting of a few star shells led the tribesmen in the Panjkhora Valley to abandon their intention to rush a camp at night. The obvious advantages of a searchlight as a means of defense for standing camps liable to hostile attack are such as to put all consideration of cost out of the question. There are no engineering difficulties involved that cannot be overcome. Another point that requires consideration is the prevention of sentries and outlying pickets being stalked in the darkness and murdered, as now frequently happens. Protection might be easily afforded by electrical means in various ways, and to disregard the many possible advantages of electricity is little less culpable than to fail to adopt the most modern rifle and ammunition.

Printed by Lightning.

[From the Mobile Daily Register.]

Yesterday afternoon there was a lone flash of lightning and an accompanying clap of thunder, and then the rainstorm which was threatening blew over. But the lightning had made a record for itself which will remain. It went into the photographing business without the aid of any apparatus except an object to be photographed and a piece of sugar candy for a receiving plate.

In the candy store of Mr. Tonsmeire on lower Dauphin street was the candy that the lightning chose to operate upon. The candy was of sugar and glucose, brown in color, and transparent. It lay on a slab on a table in the midst of the store. The article photographed was the wrapper of small American flags, then lying imbedded in some melted candy on the floor of the store, in front of the table, but not in line of view of the candy on the table. On the wrapper was an inscription in condensed gothic type, reading "National Flags." This inscription, beginning with the fourth letter of the first word and part of the third letter, just so much of the lettering as was visible on the wrapper as it lay crumpled in the midst of the sticky stuff on the floor, was taken by the lightning and transferred to a piece of the candy on the table; not transferred simply, but imbedded in it, beneath the surface the smallest fraction of an inch. It was a perfect reproduction, and perfectly black, but inserted face front just as in the original, and not reverse as would be the order of the letters if anyone should attempt to transfer them by applying the wrapper to the surface of the candy.

Sylvester D. Fosdick brought the candy to this office last night for inspection. He says that as soon as the flash of lightning came and vanished, Mr. Tonsmeire observed the printing on the candy that was before him on the slab, and exclaimed in astonishment at the sight, the candy being of his own manufacture and having had no sort of mark upon it. In a search for a clew to the sudden and mysterious appearance, the paper wrapper was discovered on the floor with those letters exposed which appeared on the candy. Mr. Fosdick says that there is a mirror in front of the table that possibly had something to do with the photographing, since the mirror is in line with the location of the wrapper; but this does not explain anything; rather does it serve to deepen the mystery.

CORRESPONDENCE.

New York Notes.

New York, September 7.—Chief Engineer Parsons of the Rapid Transit Commission is naturally chagrined at the refusal of the park commissioners to sanction his tunnel plans for the loop under Battery Park. He says that the Rapid Transit Board has done every thing in its power, short of abandoning the route, to satisfy the park commissioners; but, he continues, "In the face of all our efforts to meet their demands, the members of the Park Board kicked the whole thing over and practically blocked rapid transit south of the postoffice. The hardship of the matter is this: There is now a commission in session, appointed by the Supreme Court, to obtain the consent of the property-owners along the line of route. This we have practically obtained, and if the Park Board had given its consent the plan would have gone through at once. But the refusal of the Park Board, to which I have referred, prevents this." And thus it was for many a day.

A destructive fire occurred on Friday morning in the general repair shop of the Nassau Electric Railroad company at Thirty-seventh street and Fourteenth avenue, Brooklyn. The repair shops covered nearly an entire block, and in apprehension that the flames would sweep completely through them, three alarms were sent out in quick succession and in a short time Chief Engineer Dale was on hand with almost all the fighting force of the department. The firemen succeeded in confining the flames to the general repair shop, which was entirely burned out. The other losses included 19 trolley cars and a quantity of material used on the road. The entire loss will not fall short of $80,000, which is fully covered by insurance. There is some suspicion of incendiarism. Traffic was interrupted for only a short time.

A young tinsmith named William Jessup met a distressing death on Friady evening in the East Twelfth street plant of the Edison Electric Illuminating company. In some manner he was caught in the eight-foot fly-wheel of an engine, and before the machine could be shut down he was whirled to death. No blame attaches to the station hands for the deplorable accident. The young mechanic was at work in a dangerous position and must have made a misstep. M. S.

New England News.

Boston, September 7.—Hon. F. B. Torrey of Bath, Me., proposes to establish in New Haven or Bridgeport, Conn., a plant for the manufacture of electric motors and propellers for small boats. The portable electric motor, rudder and propeller weighs about 25 pounds, and is quickly attached to any row-boat or tender, and is hooked in the gudgeons in the same way a rudder would be placed in position. The motor, being small, is mounted on top of the rudder and operated by a battery, placed either in the bow or under one of the seats. The propeller is attached to the rudder with a shaft connecting it with the motor, the tiller arm extending around under the arm of the person steering. The power is controlled by a small rotary cock handle at the end of the tiller arm, which is always held in the hand of the man in charge. An electric switch is attached inside the handle, which controls the current either for forward or backward running. The battery will run a boat all day, it is said, and it takes only a few minutes to pour in a new solution.

F. Henry Davidson, inspector of wires for the city of Chelsea, is held in $5,000 bail for the grand jury. He is charged with manslaughter, in that, owing to his negligence, William Casey and Patrick Gavin of Chelsea were killed on the night of May 14th by coming in contact with a fallen and surcharged telephone wire at the corner of Dudley street and Webster avenue, Chelsea.

That portion of the subway in Boston which was opened to public travel a week ago, through which cars at the rate of 90 an hour are run by the West End Street Railway company, has proved a pronounced success. The opening of the first three sections of the subway dispels all doubt of the utility of the entire project, and that it will prove an important factor in transporting the public through the congested portions of the city has been demonstrated to the satisfaction of almost everybody. Everything went off very smoothly from the time the first car entered the gradient on the public garden. Every detail of the electric equipment fully came up to anticipations. The cars moved regularly and speedily over the roadbed. There was not an accident, not a hitch of any kind. C. S. G

Canadian Intelligence.

Ottawa, September 6.—The Ottawa Car company is at present working on an order from the Hamilton and Grimsby electric road for two new cars of unusual design, to be 50 feet in length and having baggage and mail compartments. These are said to be the largest electric street railway cars ever manufactured.

The capital of the Quebec Electric Street Railway company is to be increased from $320,000 to $400,000. The purpose the company has in view in expanding the capital of the railway is to enable it to complete and equip the whole line intended to be built, and that it may be finished without delay.

The effort to bring about an agreement between the Hamilton and Dundas Railway company and the Hamilton Street Railway company, in relation to the former's running rights over the street railway in Hamilton and the supply of electric power, has been unsuccessful. The Hamilton and Dundas company is continuing its arrangements to change the present system to that of electricity, and to continue on its old tracks throughout the city.

At a recent trial on the Ottawa River a new invention, called the submarine searchlight, proved a decided success. The searchlight showed the bed of the river plainly for a circumference of 50 feet; and at a depth of 35 feet objects could be distinguished without any difficulty. The object of the inventor is to enable divers to perform their work with accuracy and to trace lost treasure. It is especially adapted to assist the workers on wrecked vessels lying underneath the water at a great depth. The inventor is Mr. Joseph de l'Etoile of this city.

Sir Charles Ross, the Scotch baronet and promoter, is pushing the work on an electric power plant at Middle Falls, on the Kootenay River, 17 miles above Robson. The promoters of this electric scheme expect to have the power house built, dynamos set and wires strung within four months. They will at first furnish power to the Central Star mine. The capacity of the plant will be 10,000 horse power. The length of the transmission line will be at least 36 miles, or 10 miles greater than the distance from Niagara Falls to Buffalo. An interesting question is involved in this enterprise—its commercial success. Mr. L. B. Stilwell, electrical director of the Niagara company, says that the transmission of 1,000 horse power 26 miles is still an experiment, and until he has had actual experience in transmitting a block of 5,000 or 10,000 horse power that distance he has no opinion to express upon its efficiency. The Kootenay promoters seem to take it for granted that they can successfully transmit the 5,000 or 10,000 horse power 36 miles, and make their plant the great generator of electric power for West Kootenay.

One of the largest foreign enterprises that Canadians have undertaken will soon be under way in Jamaica. Mr. W. B. Chapman of Montreal has just returned from that island, having secured a charter and franchise from the Jamaica government to build electric tramways on the island, and it is expected that the work of construction will be begun within 60 days and continue all winter. Montreal and Halifax, N. S., capitalists furnish most of the money, and nearly a million dollars will be expended in building the first 25 miles of road in the city of Kingston and suburbs. A large power house will be built on the foreshore, and electric lighting will also be taken up. The conditions are said to be

very favorable for electric traction, as in a city of 80,000 inhabitants few think of walking the long distances; and the old street-car company, which used mules as a means of locomotion, has earned from 15 to 20 per cent. per annum for the last 20 years. The old company's assets have been purchased by the promoters of the new electric tramway service, who are Messrs. F. S. Pearson of New York, W. B. Chapman of Montreal and B. F. Pearson of Halifax, N. S. They have now secured a practically perpetual franchise, after a close contest with a Boston, Mass., syndicate. A. V. W.

Northwestern Notations.

Minneapolis, September 7.—Citizens of Oshkosh, Wis., are endeavoring to secure the removal of horse-car tracks, and the substitution of an electric street railway.

The council at Ortonville, Minn., has appointed a committee to investigate the cost of a waterworks and electric light plant.

The electric light and power commission of Marquette, Mich., has sold $25,000 electric light bonds at a premium of $2,136. The money thus raised will be spent in improving the municipal plant.

Surveys are being made for an electric railway between Union Center and Hillshoro, Wis.

An electric lighting plant is being put in at Cashton, Wis., by Benton & McDonald of La Crosse.

W. T. McCaskey of the McCaskey & Holcomb company has filed his bond to construct the electric lighting plant at Des Moines, Ia., but work cannot go forward until the injunction suit brought by the General Electric company is settled.

The street-car company is considering a plan to substitute an electric line for the present cable line up the hill at Anaconda, Mont.

R. R. Johnson has been granted the right to construct an electric light plant in Benson, Minn.

The Common Council of Hartford, Wis., has granted Rowell & Co. of that place an exclusive franchise to erect and operate an electric light plant for a period of 10 years.

Ten thousand dollars will be spent on the St. Cloud street-car improvements, the General Electric company having confidence in the future of this line, whose bonds it owns.

J. K. Tillotson is promoting the scheme of an electric railway between Oshkosh and Berlin, Wis.

Work on the electric street-car line at Boone, Ia., is progressing so satisfactorily that it will be completed next month.

A special election will be held on September 9th at Elkader, Ia., to vote on the establishment of an electric light plant.

The Star Electric company has asked the city of Dubuque, Iowa, for a five years' renewal of its contract.

W. L. Elliott of Chicago will make the plans for the Hartford, Wis., electric plant.

The street railway company has installed a modern electric system at Spokane, Wash., and the Edison Electric company has made similar improvements on its illuminating plant.

The St. Paul Board of Public Works has recommended that the city discontinue 1,000 gas lamps next year and substitute 226 arc lights.

The Sheboygan (Wis.) Council sat down on the clock column scheme proposed by the Postal Telegraph company, by introducing a resolution compelling a guarantee that the clocks would never go astray.

Some of the citizens of Council Bluffs, Iowa, are doing "tall kicking" because the Motor company asks for a new contract, claiming that it cannot proceed under the old one.

Henry C. Payne, the street railway magnate of Wisconsin, and Charles F. Pfister of Milwaukee are considering the purchase of the Oshkosh street railway. If this is done the road will be changed to an electric line.

The Council Bluffs (Iowa) Street Railway company operates a motor-car between the Iowa city and Nebraska, charging a fare of 10 cents. It now asks for a 50 year extension of franchise, and the citizens are opposing.

C. B. Luck is installed as superintendent of the electric plant at Owatonna, Minn.

The street-car service at Brainerd, Minn., is at an end, as it did not pay.

The work of setting poles for the electric light system now being introduced in Chatfield, Minn., will soon be completed.

Three storage batteries, fire and police alarm systems, are the latest improvements to be added to the city hall at Tacoma, Wash. C.

PERSONAL.

Charles D. Shain of New York is spending a few days in Chicago.

Franklin W. Kohler, of Kohler Bros., Chicago, has returned to his desk from an extended pleasure trip in the East.

W. F. Livers of Livers & Co., manufacturers of electrical woodwork at Grottoes, Va., was in Chicago early in the week.

Thomas R. Morgan, president of the Morgan Engineering company of Alliance, Ohio, died suddenly on Monday, September 6th.

G. A. Roth, a member of the well-known firm of Roth Bros., Chicago, manufacturers of dynamos and motors, is receiving the congratulations of his many friends on his marriage to Miss A. E. Huster, which took place Wednesday evening, September 1st.

T. P. Bailey, of the Chicago office of the General Electric company, is combining business and pleasure by a trip to New York and other eastern points.

Prof. Albert C. Crehore and Lieut. George O. Squier, who have been exploiting their system of rapid telegraphy in England, arrived in New York on their return on September 4th.

T. T. Flagler, president of the Holly Manufacturing company of Lockport, N. Y., died on September 5th at the age of 86. He was at one time president of the Lockport Gas and Electric Light company and of the Lockport and Buffalo railroad, and a director of the Lockport Hydraulic company.

The friends of the late Harvey L. Lufkin of New York are making up a purse for his widow, who, unfortunately, is in financial straits. A committee has been formed to undertake the collection of funds for her benefit, and James W. Godfrey, 15 Cortlandt street, New York, has kindly consented to act as treasurer. The other members of the committee are George F. Porter, C. O. Baker, Jr., Robert B. Corey and Joseph Wetzler.

ELECTRIC LIGHTING.

An election at Dublin, Ga., has resulted in favor of the issuance of the $12,000 in bonds proposed. The electric light plant and waterworks will be extended and other public betterments made.

The Interior Department, through the Indian Bureau, is inviting sealed proposals for furnishing and installing an electric light plant at the Indian industrial school at Oneida, Wis. The cost of the plant is limited to $1,000. No time is set for the opening of the proposals. Further information regarding this contract may be obtained upon application to Charles F. Pierce, superintendent, Oneida, Wis.

ELECTRIC RAILWAYS.

Washington capitalists, under the name of the American Honduras company, have secured a concession for the construction of an electric railroad, to extend from Puerto Cortez to Truxillo, Honduras.

The Kansas City and Eastern Railway company has been incorporated with a capital stock of $50,000, to build an electric road from the end of the Westport cable line to Leeds. Among the incorporators are B. F. Robinson and John Hoffman of Kansas City, and Henry Pfeiffer, Westport, Mo.

It is stated that the City Passenger Railway company of Baltimore has been considering the idea of using the trolley system on its Madison avenue and Gay street lines in place of cable cars, and that the work of construction for these improvements may be commenced before January 1, 1898.

The Leavenworth (Kan.) and Lansing Electric Railway company has been incorporated with a capital stock of $150,000, to build an electric road between the cities mentioned in the title. The directors include C. B. Leavel and W. E. Winner of Kansas City, Mo., and E. B. Merritt of Lansing, Kan.

The Baltimore & Northern Electric Railroad company has recently purchased 22 cars for the line which it is now building and for the road running between Pikesville and Emory Grove, Md. About one-half of the railroad between Baltimore and Pikesville has been completed, and work is progressing upon the overhead structure, which is to cross the Northern Central railway tracks at Mount Washington, Md.

TELEPHONE.

G. A. Gillette, representing P. A. Gillette & Co. of Saginaw, Mich., has made application to the Town Council of Daytona, Fla., for franchise for the establishment of a long-distance telephone system.

Advertising in the daily papers is one of the resources of the Metropolitan company of New York. "Telephony is the spice of trade" is a newly promulgated maxim found in the advertising columns of the New York dailies. No name is appended to this declaration, but it is not doubted that the local Bell exchange is authority for it.

TELEGRAPH.

The commisioner of public works of Chicago has ordered the Western Union Telegraph company to take down its poles and place its wires underground in Wabash avenue, between Twelfth and Eighteenth streets and in Thirty-fifth street between Michigan avenue and Western avenue.

Information received at Washington on September 6th indicated that the last link in the line of the French cable would be completed in midocean in about 10 days. The American connection at Cape Cod is completed. The question has been raised as to the right to land a cable of a foreign company, and there appears to be much doubt as to the law. The French company has urged that the line was a renewal of the old line and not a new line. It has also pointed out in a communication to the Senate committee on commerce that the line was of strategic importance to the United States, as it is said to be the only cable which does not pass over British territory. The cable was first laid under authority given by the president, through Secretary Evarts, in 1879, and recently the French company has been replacing this line with a new copper cable.

MISCELLANEOUS.

An electrical power plant is to be installed in the factory of the W. W. Kimball company of Chicago, which manufactures pianos and organs. There will be a 180 kilowatt alternator and several motors. Westinghouse apparatus will be used.

The new tariff of Japan places a duty of 10 per cent. on electric light machinery, 25 per cent. on phonographs, 10 per cent. on telephones and telephonic apparatus, 10 per cent. on telegraph wires, galvanized, and a like percentage on submarine and underground cables.

It is stated that prosperity has struck the lead industry and the market is on the up turn. Prices are higher than they have been for the last five years, with the prospect of attaining the highest point in the history of the metal. Missouri mines which were on the point of closing down have resumed operations full blast and will produce a larger tonnage than ever before. Since August, 1896, when the price of lead reached the lowest point, it has been gradually advancing, until last week it was quoted at $4.05 to $4.10 per hundred. It is predicted by competent authorities that the price will reach $4.50 before the close of the year.

ELECTRICAL SECURITIES.

A notable increase is shown in the earnings of the Nassau Electric Railroad company for the year ended June 30th. Its gross receipts amounted to $1,825,272, its operating expenses and fixed charges being $1,754,674.

The Brooklyn City and New Town Railroad company paid dividends of $80,000 in its year ended June 30th. The receipts amounted to $519,374, and a surplus of $642 was left in the treasury after paying operating expenses, fixed charges and dividend. Last year $100,000 was divided among the stockholders.

The Buffalo Railway company's annual report shows a surplus of $40,087 after paying operating expenses of $668,852 and fixed charges of $427,123. The gross earnings showed a falling off of $48,684. The Crosstown Street Railway company, Buffalo, shows a marked improvement over last year. Its gross earnings were $465,431, as against $444,031 in 1896, while the operating expenses were $312,733 last year and $292,785 the preceding 12 months.

The General Electric company is now half through its fiscal year, but results to date in net figures have not been as good as the first half of the previous fiscal year, according to the Daily Financial News of New York, which on September 6th said: "If there is no improvement before the end of the year the General Electric common stock will earn at least one per cent. less than it did last year. The present business of the company is understood to be showing up very well, in that the foreign company in which the General Electric company owns a controlling interest has secured the underground contract in London."

In the Chicago market during the week Lake Street "L" has been active and firm on the prospect of betterment of earnings through operation around the loop and connection with the Suburban railroad. With the addition of only eight stations and small increase in pay rolls the traffic will be increased materially, and the Suburban railroad will soon be connected with the elevated line, giving through passage from Riverside to the heart of the city. The net earnings of the Lake Street are now slightly above those for the corresponding period last year, due largely to the decreased operating expenses. West Chicago was more active, with fair buying at 108. The traffic in August showed a steady gain and the travel in the first week of September has been above the average of last year. The earnings for 1897, it is estimated, will exceed eight per cent. on the stock, against seven per cent. last year. The Metropolitan elevated railroad has been benefitted during the month of August by traffic of the Suburban road, which was about 38,000 a day, or an increase of a few hundred passengers a day over the traffic for July and an increase of more than 2,500 over the traffic for August of last year. The plan of reorganization for the road is likely to be announced before the end of the present year.

TRADE NEWS.

The Daily Financial News of Pittsburg says that $50,000 was the price paid for the Gibbs company's business by the Westinghouse company.

A neat and nicely illustrated price-list has been received from Machado & Roller, 203 Broadway, New York, sole selling agents for the A. E. G. incandescent lamp, manufactured at Berlin, Germany. This little book gives a complete illustrated story of how incandescent lamps are manufactured in the large establishment of Allgemeine Elektricitaets Gesellschaft, one of the largest concerns of the kind in the world. It is understood that Machado & Roller will carry in New York a large stock of incandescent

lamps of all voltages to meet any demand up to 100,000, which gives them an opportunity to take care of any reasonable order.

F. W. Bunts, formerly assistant secretary and treasurer of the Walker company of Cleveland, Ohio, has bought out the Cuyahoga Supply company, dealer in electric street railway and lighting supplies and general selling agent for Eugene Munsell & Co. and the Mica Insulator company in Cleveland and Northern Ohio. Mr. Bunts will continue the business under the same title as formerly, occupying the offices at 102 Superior street. He is a young man who has a large acquaintance in the city of Cleveland and vicinity, and his association with the electrical trade will no doubt bring to his company a large business. His leading lines, to which he will devote his especial attention, will be the "Micanite" specialties, as manufactured by the Mica Insulator company of New York, Chicago and London, and Eugene Munsell & Co.'s India and amber mica in all of its various forms. The electrical trade of Cleveland and vicinity will find that a large stock of these lines will be carried ready for immediate delivery.

Francis B. Badt has resigned his position as secretary of the Siemens and Halske Electric company of America to engage in business with Edward W. Meysenburg as "brokers, contractors and engineers in railway and electrical equipment, appliances and construction, experts in patent causes and consulting engineers." Headquarters have been established at 1522 Monadnock building, Chicago. The new concern will be known as Meysenburg & Badt, Mr. Badt being president and Mr. Meysenburg secretary and treasurer. Mr. Badt has been prominent in electrical circles, especially in Chicago and the West, for many years. He is an experienced engineer and designer and is familiar with the design, construction and operation of standard apparatus for lighting, railway and power work. He has made a special study of transmission of electrical energy and has had valuable experience in every field of electrical development. Mr. Meysenburg has been associated with his brother, O. W. Meysenburg of the Wells & French company, who, with Mr. Wright, organized the American Siemens and Halske company in Chicago.

BUSINESS.

The Swett & Lewis company, 11 Bromfield street, Boston, has enlarged and improved its plant for the production of X-ray supplies, and is now prepared to fill orders promptly.

Charles Holmes, purchasing agent of the Chicago Edison company, has returned to Chicago after a pleasant vacation at Fox Lake. Mr. Holmes is now, to quote his very apt expression, "ready to receive large orders and dispense small ones."

The Missouri Telephone Manufacturing company of St. Louis closed two large deals early in the week. One order is for a complete exchange at Fayette, Mo., and the other is for 200 instruments and a switchboard to be shipped to Los Angeles, Cal.

The Walker company has its own ideas of the proper manner of selecting a dynamo, and in the pamphlet "How to Select a Dynamo" these ideas—and they seem to be good ones—are clearly set forth. The reader is posted on efficiency, regulation, cool running, sparking, durability, ease of repair, etc., and many suggestions of practical value are made. The good points in the electrical and mechanical design of the Walker machines are not neglected.

Thomas C. Perkins has recently accepted the position of assistant general sales agent for the C. & G. Cooper company of Mt. Vernon, Ohio, in connection with the Boston office of the company. The territory in which Mr. Perkins will operate will be principally in New England. Mr Perkins is well known in the electrical fraternity, and will be remembered as having been formerly connected with the Ball & Wood Engine company of New York. He is an energetic and popular salesman.

The Jandus Electric company of Cleveland, Ohio, makes announcement that it is the sole owner of the patents of William Jandus and the sole manufacturer of the enclosed arc lamps made under those patents and heretofore sold as "Manhattan." The company has now organized a sales department, and will sell the lamps directly to agents, dealers or customers, instead of marketing its products through a general sales agency. The "standard Jandus lamp" is the same as that formerly sold as "Manhattan," many thousand being now in use throughout this country and abroad.

The Zamel Arc Light Meter company, through President C. C. Schumacher, reports that it is progressing finely in the matter of introducing its very useful instrument. The Zamel meter has just been approved, Mr. Schumacher states, by the National Fire Underwriters' association, a letter from the association to that effect having been received a week or so ago. The Zamel meter, or, more properly, the "current timer," is a device well worth the investigation of every arc light central station man who finds it difficult to run lights on the contract system and who finds customers more willing to buy their light by the hour.

C. H. Thordarson, who for many years has been engaged in constructing and repairing dynamos, motors, transformers, induction coils, etc., has now built up an excellent trade in Chicago and enjoys an enviable reputation among the electrical fraternity. He has for some years done considerable repair work for the Chicago Telephone company, Postal Telegraph-cable company, Central Union Telephone company and the Western Union Telegraph company of Chicago. Mr. Thordarson makes a specialty of winding armatures of any size or system, and his shop is exceptionally well fitted for work of this kind. His office and shop are located in the Electric block, 82 Market street, Chicago.

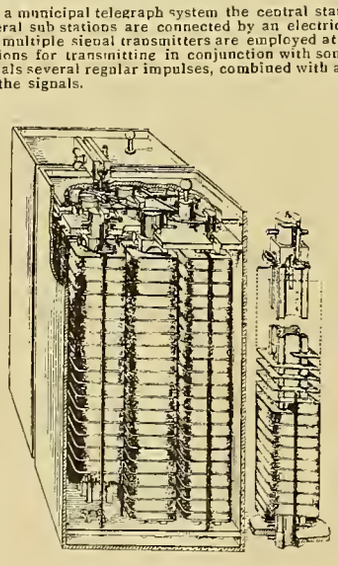
The Electric Appliance company is well pleased with its experiment of carrying in stock in Chicago a line of porcelain in all styles and sizes of knobs and tubes, that enables it to fill any order. The advantage of having this stock in Chicago, instead of having to go to the factories for the material, seems to be appreciated by the trade, and the Electric Appliance company is reaping very satisfactory results. It is the Chicago depot for one of the largest porcelain works in the country, and is carrying what is claimed to be a much larger and better assortment of porcelain than has ever been carried in Chicago before. A customer's requirements must be very severe, indeed, if he cannot satisfy his wants directly from the Electric Appliance company's stock.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued August 31, 1897.

588,965. Municipal Signal System. Howard F. Eaton, Cambridge, Mass. Application filed November 24, 1888. Renewed February 1, 1897.

In a municipal telegraph system the central station and several sub stations are connected by an electric circuit and multiple signal transmitters are employed at the sub stations for transmitting in conjunction with some of the signals several regular impulses, combined with a register for the signals.



NO. 589,042.

588,997. Electric Alarm and Call Bell. Frank C. Jordan, Wadsworth, Ohio. Application filed January 11, 1897.

The clock has its hour-hand connected with one pole of a battery, contact fingers adapted to make connection with the hour-hand and connected with a switchboard, a series of contact plates connected with the switchboard.

588,999. Electric Meter. Elton J. King, Fort Wayne, Ind. Application filed May 1, 1897.

An electric meter, comprising field coils and a plurality of movable coils secured at an angle to each other upon a common axis within the field, connections for energizing the coils and means for measuring the resulting torque.

589,015. Electrical Body Appliance. James P. McGill, Chicago, Ill. Application filed February 23, 1897.

A flexible battery belt has continuously arranged galvanic or voltaic couples, insulation between the adjacent couples and flexible connection between the couples and insulation.

589,042. Storage Battery. William J. Still, Toronto, Canada. Application filed February 10, 1896.

An electrode is described, comprising a rectangular continuous hollow spiral of flat strip sheet-lead form with both edges free, and an interposed hollow spiral of active material exposed at the inside and outside, and a supporting post for the electrode extending up within the spiral and forming a guide for the free lengthwise movement of the spiral.

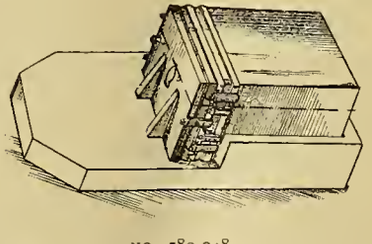
589,048. Electric Dental Furnace. Charles A. Timme, New York, N. Y. Application filed March 14, 1896.

Claim is made for the combination of a muffle composed of refractory material, removable independent heating plates disposed in the walls of the muffle and composed of refractory material having conductors embedded therein, two separate conductive straps surrounding the muffle near its front end, each provided with a plurality of binding posts for establishing connection with the electric source and with the heating plates independently of each other.

589,073. Electric Regulator for Dynamos. William H. Chapman, Portland, Me. Application filed April 4, 1896.

The claim: In combination with a dynamo having a shunt winding on its field magnet, a rheostat connected in circuit with said shunt winding, a solenoid electrically connected with the terminals of said dynamo, and having a movable iron core arranged and adapted by its magnetic force to operate the arm and slider of said rheostat; an adjustable retarding device consisting of a cylinder, a piston and piston-rod, said piston-rod being attached to said core at one end, and at the other end being threaded to receive the piston, and having a passage through it which the piston is arranged to close or open according as it is screwed to different positions along the rod

589,093. Automatic Switch for Railroads. Loring A. Moore, Brooklyn, N. Y. Application filed April 10, 1897.



NO. 589,048.

Included in this device are an insulated track section, a movable switch-point forming a part thereof, an inclosing case beneath the insulated track section, a weighted elbow lever pivoted within the case, engaging the switch-point and tending to keep the switch open at all times to the main line, an electro-magnet arranged in position to attract an armature on the elbow lever and close the switch to the main line when an electric circuit is completed through the magnet, and electrical connections between the insulated track section, the magnet and the ground.

589,112. Electric Car Lighting System. Frederick M. Bennett, New York, N. Y. Application filed January 4, 1897.

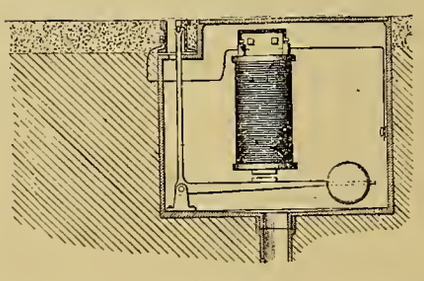
The dynamo is actuated by the hub of the vehicle wheel and charges a secondary battery, and a switch is provided for directing the current to the secondary battery, consisting of an armature controlled by the field of the dynamo.

589,130. Electric Headlight. John Kirby, Jr., Dayton, Ohio. Application filed February 15, 1897.

In the dashboard of the car there is an opening cut through, and a headlight is there placed, with the front or open end of its casing secured to the rear side of the dashboard and registering with the opening.

589,170. Railway Signal. Charles W. Grant, Concord, Mass. Application filed November 19, 1896.

The device employs a series of track coils, an inducing coil carried by the locomotive for generating current in the track coils, an alternating current generator energizing the inducing coils, a test coil placed adjacent to the inducing coil, and indicating devices in the circuit of the test coils.



NO. 589,093.

589,186. Means for Operating Generators and Storage Batteries in Conjunction. Wynn Meredith and Andrew M. Hunt, San Francisco, Cal. Application filed September 8, 1896.

The apparatus employed includes an auxiliary dynamo, storage battery and main dynamo, the armature of the auxiliary dynamo and the storage battery being connected in series, and the two being in shunt with the main dynamo, the auxiliary dynamo having two independent field windings magnetically opposed, one being in series with the external circuit of the main dynamo, and the other in shunt with any source of approximately constant potential difference.

589,252. Apparatus for Refining Metals by Electrolysis. John O. S. Elmore, Kapurthala, India. Application filed August 17, 1896.

A series of cross-frames is arranged in a closed tank at intervals; plates or slabs of the metal to be refined are inclosed within the frames; appertures are arranged in the alternate ends of the frames, an anode plate and outlet pipe being in one end of the tank, a cathode plate and inlet pipe at the other end of the tank, and an electric circuit connected at its terminals to the anode and cathode plates.

589,347. Electric Piano. James L. Fulkerson, Kansas, City, Mo. Application filed December 4, 1896.

A pivoted key is provided with a longitudinal slot, a wire extending within the slot, a contact point arranged at the front end of the key and connected to the wire, a platinum spring at the opposite end of the key having connection with the wire and maintained in electrical contact with the circuit wire, and a contact plate arranged under the front end of the key.

Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, SEPTEMBER 18, 1897. No. 12

Electrical Illumination of the Tennessee Centennial Exposition.

By W. D. Williams.

Perhaps no feature of the Tennessee Centennial Exposition at Nashville is so thoroughly enjoyed by all classes of visitors as is the electrical illumination. There are no startling features connected with the plant in the way of electrical novelties. Reliance is placed, rather, on the general effect and beauty of the lighting, and these are certainly striking and undeniable.

In the generating plant are 15 dynamos, as follows: Six General Electric alternators, which have a capacity of 120 kilowatts each; two Brush multi-circuit arc machines, with a capacity of 125 lights each; two Western Electric arc machines, rated at 100 lights and 80 lights respectively; one 300 candle power, which are used for outside decoration and inside illumination, and 446 arc lights so distributed over the Centennial Park and buildings as to give the best illumination possible. The buildings are all well lighted with arcs, while the incandescent lamps at the different exhibits give a most pleasing effect.

All the exposition buildings are outlined with incandescent lights, while the side buildings on Vanity Fair are gaily decorated with many-colored lights as suit the fancy of those who have them in charge. The agricultural building is perhaps the most beautiful in original design and requires over 1,800 incandescent lights for outside decoration. The style and contour of each building has been followed in the electrical decoration, so that a person entering the exposition grounds by night for the first time can distinguish the style and architecture of each building by looking at the illuminated parts.

Parthenon, with Corona of Arc Lights on Flagstaff above. Commerce Building. Memphis Pyramid.

ELECTRICAL ILLUMINATION OF THE TENNESSEE CENTENNIAL EXPOSITION.

Wood arc machine, capable of supplying 40 lights. This constitutes the apparatus at the power house and is used solely for lighting purposes. In Machinery Hall there are four other dynamos, consisting of one Triumph 75 kilowatt 500 volt generator, one 62 kilowatt 500 volt General Electric generator, one 2,000 light direct-connected 110 volt machine made by the Western Electric company, and one 800 light 110 volt Wood dynamo. The engines which drive the power-house dynamos include four Westinghouse compound engines with a capacity of 400 horse power each. To these four engines are belted six alternators and four large arc machines. A 50 horse power Beck engine is used to drive the Wood arc machine. In Machinery Hall the Triumph generator is directly connected to a Weston engine. The Western Electric 110 volt machine is directly connected to a Phœnix engine, while the General Electric generator and the Wood dynamo are driven from line shafting operated by a Hamilton-Corliss 500 horse power engine. The switchboard arrangement at the power house is excellent. The alternating switchboard consists of six panels of beautiful variegated marble, very handsomely finished, and is so wired that any combination can be obtained. The arc board is of the well-known Brush make of the latest improved type. There are 17,482 incandescent lights, ranging from two to

All the wire used within the park proper is underground and was supplied by the New York Safety Wire company in the form of lead-covered cable, of which there was eight miles laid. Forty-one men are employed in the electrical department of the exposition, and by a system of individual reports a complete record of the operation of the entire plant is kept, and the superintendent can locate at a moment's notice any trouble that may occur. There are eight inspectors whose duties are to make a thorough inspection daily of the lines and circuits, while nine linemen look after the line work. In addition to the daily inspection by the operating department, magneto tests are also made, while nightly tests are made of all the circuits while the current is on.

An interesting feature of the lighting of the fair is the corona of arc lights hung on the main flagstaff, 210 feet from the ground. This cluster of lights is used as a signal for turning on all the lights of the exposition, and is operated from the power house, which is located three-quarters of a mile away.

J. W. Pentecost, who designed and executed the electrical display is a young man, 38 years of age, who received his education in the public schools of Nashville. He began the study of electricity about eight years ago, and, seeing the great possibilities offered for a young man in this field of work, applied himself diligently to the task of training himself. How well he accomplished his task is seen in the brilliant display at the exposition. He was chosen from among a great many other applicants for the responsible position of general superintendent of the electrical department by Director-general Lewis, who had implicit faith in his ability. Mr. Pentecost has worked his way up from the ranks, having served his time as a lineman and in other subordinate positions. He was a foreman at the Atlanta Exposition, where his ability was recognized. He prepared the plans for the electrical equipment of the Tennessee Centennial, and when they were submitted to the officials in charge not one change was made. To the great credit of Mr. Pentecost it may be said that the Tennessee Centennial is the first exposition where the entire electric light plant was ready for business on the opening night. At that time every light on the ground was burned. Every lamp has burned every night since, and the plant has given no trouble.

The general night effect is beautiful, and an idea of the appearance of the illuminated buildings, towers, bridges and waters of the exposition grounds may be had from the accompanying pictures.

Prominent among the electrical features of the fair are the powerful searchlights on the giant see-saw on Vanity Fair. The light from these great lamps penetrates far into the gloom of the night and can be seen a distance of 30 miles, as it sweeps the country with its powerful rays. The illumination at the chutes is from a different source from that of the rest of the exposition, yet for brilliancy and general effect it is the most conspicuous as well as the most prominent illumination on Vanity Fair. Situated at the end of the grounds, on a high hill, its light can be seen from all parts of the exposition park. Surmounted with a cupola of 70 incandescent lights, the chute boats glide down a descent under an arbor of 12 arches of colored lights, whose blending effects are most beautiful. A single row of incandescent lights runs along the guard railing and the loading plat-

forms, while the refreshment and band stands are beautifully decorated with many-colored stars. The entrance to the chute presents a dazzling effect, being a crescent around whose edges and sides are placed an innumerable number of lights, while "The Chutes" appears in large letters in varied colored lights which can be seen the entire length of Vanity Fair. There are 630 incandescent and 10 150-hour arc lights, supplied from a separate dynamo of 80 kilowatts capacity. Three 30 horse power motors are used, one for running the hoisting drum, one for running the endless chain that drags the chute boats to the top of the incline, and one for furnishing water to the pump. This plant is quite an interesting feature to the exposition visitor.

J. W. PENTECOST, GENERAL SUPERINTENDENT ELECTRICAL DEPARTMENT TENNESSEE CENTENNIAL EXPOSITION.

The Edison Convention.

For the first in the history of the Association of Edison Illuminating Companies outsiders were admitted to the opening session at the Niagara Falls meeting this week. It was considered a great concession, and taken as an indication of an improved condition of mind that might eventually develop to the point where the entire proceedings would be given to the public. But it is hardly to be expected that the present generation will witness such a complete transformation. It will be noticed that those sessions at which papers are read and discussed were held, as usual, behind closed doors. However, it was not at all difficult for those who were inquisitive to find out the trend of the opinion expressed at these meetings.

The attendance at the convention was excellent in point of numbers and in the prominence of the members. There were among the "outsiders" many old Edison men now engaged in other enterprises, who, however, had not lost interest in the organization, and took this means of recalling and renewing old friendships. It was noticeable, too, that among the members were found many who had been identified with interests opposed to the Edison companies in the early days.

The convention was held in the Cataract House, the hall being admirably adapted to the needs of the association. The first session was called to order shortly after 10 o'clock on Tuesday morning, the first order of business being the reading of the annual address of the president. At its conclusion a vote of thanks was unanimously tendered President Insull for the interesting document he had contributed to the history of the organization, and also for the highly valuable services he had performed in the interest of the organization during his term of office.

Letters had been received from Mr. Edison, Mr. Tesla, Frank Sprague and Edward H. Johnson expressing regret at their inability to attend the opening session. Messrs. Sprague and Johnson, however, gave promise of putting in appearance at a later day. It was announced that J. H. Vail of Philadelphia had been seriously injured in a recent accident, which explained his absence. Much regret was expressed by the members for their old associate.

During the morning meeting the ladies accompanying the members were entertained by a tally-ho drive under the guidance of Wilson S. Howell.

President Insull's Address.

The decision of the members of the association at the last annual meeting to hold its eighteenth convention at Niagara Falls was naturally dictated by the world-wide interest in the work of generating and distributing electrical energy, using the famous Niagara River as a prime motor. In assembling at a spot where so much can be learned by those engaged in electrical business, we are, as an association, paying the highest tribute that we can to the wonderful work of those who have had the courage, as capitalists and engineers, to design and build a plant which has given a great impetus to the economical production of electric current, not only by means of water as the prime mover, but by all other methods for the production of electrical energy. We cannot all have the advantage of a large water power to assist in the economical production of our product right at our threshold, but in studying the methods employed here at Niagara Falls there is much information that we can take away with us which will lead us to concentrate our works at the most economical point of production in the various cities in which we live, and we can take advantage of the methods of distribution here employed to distribute our current to distant points where we desire to use it, far more economically than we can produce it at those distant points themselves.

The question is often asked by those engaged in the electric light and power business why the companies known as "Edison Illuminating companies" or "Edison licensees" should find it necessary to combine themselves into an association. This question is best answered by the fact that the Edison Illuminating companies all operate under practically the same form of contract with the company that controls the Edison patents, namely, the Edison Electric Light company. In the main they purchase their goods, under contract, from the same licensed manufacturer of the patent-owning company, namely, the General Electric company, and as there is but one Edison company in each particular city, the interests of these various companies are naturally mutual. When I remind you that the various companies which we, either as officers or employes, have the honor of representing here, have invested in their business more than $105,000,000, it will be readily appreciated that it must be greatly to the advantage of the various properties which we operate that we should meet from time to time to exchange ideas as to the proper conduct of our business, and that we should continue an organization to watch over our interests in our dealings with the patent-owning and manufacturing side of the Edison business.

At what happily would appear to be the close of an unparalleled period of industrial depression, the various Edison Illuminating companies have certainly much cause for mutual congratulation. Notwithstanding this long period of paralysis of industrial enterprise, they have, with hardly an exception been able to show good earning capacity and to pay to the holders of their securities a substantial return on their investment. This is partly owing to the inherent merit of our business, partly to the wise foresight of the illustrious inventor whose system this business is based on, and partly to the conservatism of the original projectors of the Edison lighting and power business, who insisted that the Edison Illuminating companies should be established on a sound financial basis.

This experience during the depressed times will necessarily lead investors to the conclusion that the securities of the Edison Illuminating companies are among the most desirable of local investments, as if it is possible to earn substantial returns on capital invested during such periods of business disturbances as that which we have recently gone through, surely we can look forward to laying up a substantial surplus to provide against a "rainy day" during times of prosperity which all of us hope and some of us think we are now entering upon.

The use of large generating units in the large stations for the production of electrical energy, inaugurated but a few years ago, and the necessity of extending the field of our operations into distant portions of our territory, has forced upon many of us the desirability of employing more economical methods of transmission, with a view to the abandonment of small and expensive stations and the concentration of our production of current at the point of greatest economy. This matter was touched upon a certain extent during the last convention. A number of our companies are now spending large sums of money on these lines, and as a result of the importance that this subject has assumed, it is but natural that a considerable portion of our time will be occupied in deliberating on this subject.

In connection with the matter of economical transmission, the subject of economical storage is naturally of importance, and we should, in the course of our proceedings, be able to obtain considerable information on the advantages of the use of the storage battery in connection with the Edison system from those who have had the courage of their opinions and have invested largely in storage battery plants. I think we all concede the advantages to be obtained from the use of the storage battery from the storage point of view only, but some of us are still in doubt as to our ability to save sufficient money from their use to justify the large investment in capital they call for.

A subject of prime importance with the economical production of our product is the basis upon which we shall sell it to our customers. It should be remembered that we are engaged in a public business, and that our companies have duties to perform to the public as well as money to earn for our security holders. In fulfilling our obligations to the public the question of the basis of charging for our product is the all-important one. This is a matter which on previous occasions has received your earnest attention, and is one on which there will undoubtedly be earnest discussion on this occasion.

For several years past some of the larger illuminating companies, members of this association, notably those of Boston, New York and Chicago, have been in the habit of comparing the details of cost and selling price of their product, their accounts being kept on the same basis, as near as local conditions permit. The information obtained, so far as my experience goes, has been of great advantage in enabling the companies in question to reduce their cost and assisting them to an intelligent decision as to the policy to adopt toward their customers.

It seems to me that it would be advantageous to the members of this association if a uniform system of accounts were adopted and arrangements made to compare the results obtained by the various companies operating under similar conditions. In putting such a scheme into operation a number of difficulties would naturally have to be overcome, such as the differences in local conditions and the necessity of carefully guarding information of so confidential a character, but I would suggest the desirability of the association instructing the executive committee to take this matter up, with a view to formulating a plan which might be tried experimentally.

The changes that have taken place from time to time since the formation of this association have rendered it desirable that some modifications should be made in our by-laws. A report will be made to you during our meeting, setting forth the changes suggested, which have been discussed and approved by the executive committee of your association.

The main business of your executive committee during the past year has been the negotiating with

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the General Electric company of a contract and specifications with relation to the incandescent lamps used by the Edison licensees who are members of this association. As a result a lamp-testing bureau has been established at the lamp factory at Harrison, N. J., which bureau is under the control of this association and is operated for its account by Mr. Wilson S. Howell. A number of our members have taken advantage of the arrangements made, and we believe that considerable benefit will accrue to those who arrange to purchase their lamps under the contract in question.

Great credit is due to the chairman and members

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of the executive committee for the results they have been able to achieve, and they are certainly deserving of our thanks for the time and money they have spent in this matter for our benefit. I think for the first time in the history of the electric lighting business we are now able to obtain lamps made according to specifications agreed on, and the result must be an improvement in our service and a saving of money to our central station companies. The details of this matter will be carefully dealt with in reports by Mr. C. L. Edgar, chairman of the executive committee, and Mr. Wilson S. Howell, the testing officer in sharge of the bureau at Harrison.

The relations of the Edison licensees with the Edison Electric Light company and its licensed manufacturers, the General Electric company, have, during the past year, been of the pleasantest character. This is probably owing to the fact that those operating the General Electric company since the consolidation of the Thomson-Houston company and the Edison General Electric company have had fuller opportunity, as time has gone on, to appreciate the importance of the Edison licensee business to the patent-owning and manufacturing interests.

The matter of patents continues to be in far from a satisfactory condition, the licensees receiving very little protection in the enjoyment of the exclusive privileges under the Edison patents which they had every reason to look for in view of the large amount of royalty paid by them to the patent company. It is doubtful whether the Edison Electric Light company or the General Electric company can be held responsible for this state of affairs, as they have continued to spend very large sums of money in the prosecution of their patent rights in the courts.

It is to be regretted that many of the electrical manufacturing companies continue to foster opposition central station plants in territory already covered by good-paying illuminating properties, with the result of seriously affecting the credit of the customers upon whom the manufacturers must rely for trade, if they desire to create a permanent manufacturing business. We have all of us suffered more or less from this policy of the manufacturing interests, and while in some cases there may possibly be a temporary advantage to one or another manufacturer, it is natural for us to wonder what permanent advantage can come to the manufacturing interests as a whole by the adoption of methods which would seem to have in view the ultimate destruction of the goose that lays the golden egg.

With the many changes that must of necessity take place in so new a business as the electric light and power industry, the question is often raised as to whether or not our plant is of a permanent character. A close examination of the Edison system must bring home to anyone the fact that the wonderful inventive and engineering talent displayed by Mr. Edison in his early work has given us the advantage of a system that is of the utmost permanency. Our main investment, in the larger cities at least, is in our underground work, and if you will look over the records of the various companies using the Edison system I think you will find that their underground work is as useful to them now as when it was laid, and it seems to me that there is no reason for us to fear that this condition will change in the future. We may have different methods of illumination; we may get a higher voltage lamp; we may find that the current of the future will not require as large a cross-section of copper as in the past; but I doubt if we will find that any method of distribution will be invented that will supplant that which we are using; and if such be the case, we should rather welcome than fear new inventions, feeling that in our own particular cities we are the most desirable purchasers of any inventions which may lessen the cost of electrical energy to our customers. When those of us who have been connected with this great industry from its early childhood recall the fact that scientists and inventors on both sides of the Atlantic persistently condemned the scheme originally laid out by Mr. Edison we must, as central station managers of today, feel that we owe a deep debt of gratitude to him for his courage in insisting that the only practicable method of distribution of electrical energy was by the use of a constant pressure and a varying current, when everybody else was talking a constant current and a varying pressure. This is no occasion for invidious comparisons, but with every desire to pay the highest tribute to the many brilliant men who have contributed to the success of the business of manufacturing and distributing electrical energy, we venture to claim that their work is all subordinate to the master mind who persisted in the early experimental days at Menlo Park in working on a multiple arc system, without which (with the exception of the series arc light) no form of electric light or electric energy could be commercially operated to-day.

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Proceedings of Executive Sessions.

At the first executive session Louis A. Ferguson, general superintendent of the Chicago Edison stations, read an interesting paper upon "Economy in the Distribution of Electrical Energy," which, together with a resumé of the discussion, is presented on another page. The reading and discussion of this paper occupied the remainder of the session.

At the evening meeting there were two papers presented. George R. Stetson of New Bedford read a paper describing and illustrating the use of the photometer in the gas industry, the unit of measurement being the English standard candle and the photometer being of the Bunsen type.

In the discussion, J. W. Lieb, Jr., referred to the Lummer-Brodhun photometer and the Hefner von Alteneck standard light, with incandescent lights as secondary standards, and compared details of these devices. He also called the attention of the members to the arrangements which had been made for the supply of calibrated incandescent lamps of 16 candle power for practical use as station standards.

S. Dana Greene noted the difference among authorities as to classification of incandescent lamps, some observing mean spherical candle power and others adhering to the customary classification by mean horizontal candle power. The subject was further discussed by Messrs. Howell and Bowker.

Caryl D. Haskins of Boston presented an illustrated paper describing "Recent Developments in Electrical Measuring Devices," including a prepayment wattmeter, improved station wattmeters and telltale dials for the same, storage battery wattmeters showing the state of charge of a storage battery, and new switchboard instruments. The discussion which followed was of a general character and showed the interest of the members in the matter. It was in the main an exchange of experiences with meters.

The committee on acetylene gas and Welsbach burners presented a report, which was accepted. This closed the first evening meeting.

At Wednesday's morning's meeting the first order of business was consideration of the report of the treasurer, which was presented and accepted.

J. W. Lieb, Jr., of New York read a paper on "Methods of Charging for Current." He discussed 10 methods in use, as follows: Flat rate; flat rate with connection to circuits shut down at agreed hours; discounts computed on duration of demand, based on the stated time of closing of the customer's premises; special rates for motors; discounts on gross bills; discounts based on average use per day of units installed; the Hopkinson system—a fixed annual rental based on customers' load factor, and an additional charge per unit used; double discounts, one on gross bill and a second on average use of installation; the Wright system with demand meter; the Kapp or double rate system, the maximum rate being charged at the hours of the peak of the station load and a lower rate during the remainder of the 24 hours; and lastly, a set of tables showing the rates and methods of charging of 12 large stations.

In a written review of the subject, A. S. Knight of Boston acknowledged the value to the industry of the analysis of costs which had been made and published by English electric light men, particularly Arthur Wright. He admitted that American rates had generally been made with too little analysis of cost of product; but he objected that the Wright system went too far in the other direction by disregarding the wholesale feature of sales to large consumers. W. S. Barstow read a carefully prepared statement of the situation, and showed diagrams which emphasized the effect on cost of product at different hours of the demand variation from hour to hour, and particularly the value of a high load factor in reducing possible selling price. He recommended the double rate system of charging with a constant minimum rate in effect at all but the "peak" hours; the minimum rate being calculated to begin with, and any readjustment toward lower rates due to reduced cost of production to be made by lengthening the hours during which the minimum rate should be in effect. The "Kapp"

system and a Kapp meter made from one of the common type of meters by the addition of a self-winding clock attachment were his preferences as to the manner of applying the double rate. A general discussion ensued at this point, questions being asked of the delegates who had spoken in order to elucidate their methods of apportioning costs of production. The interest in the subject was so general that it was determined to continue the discussion at the evening session, and at that time the matter was again brought up. Every man in the association presented his views and experiences, and at a late hour the meeting adjourned.

On Thursday morning Charles E. Pattison presented a paper entitled "Storage Battery Progress and Results in the Edison Boston Station." The paper embodied a record of three years and six months' experience with the first battery, two years and three months with the second and one year with the third. His conclusions were that his company's experience to date indicated great benefits from the batteries, and that while they had weaknesses, the expense of maintenance was not so great as for some of the other apparatus in use. The most notable benefits were the better regulation of pressure on the system, particularly the elimination of fluctuation due to intermittent motor loads, such as direct-connected elevators, the improvement of generating economy, due to the custom of charging the batteries during hours when the load would otherwise be light, and the reduction of expense hitherto necessary in keeping furnaces banked and engines ready for emergency use. The discussion by R. R. Bowker, W. S. Barstow, J. W. Lieb, Jr., L. A. Ferguson, Samuel Scovil and others showed differences of opinion among the members having experience with batteries as to which of the advantages to be gained by their use was very important. The expression varied between those given by Mr. Pattison and that by another delegate, who was of the opinion that the immediate availability of the battery as a reserve in case of accident to the generating plant was its principal recommendation.

J. W. Lieb, Jr., presented the report of the committee on storage batteries, which, among other matters, contained a recommendation that a rating of battery capacity more conservative than that heretofore in use by the manufacturers should be adopted. The report of the executive committee and the report of the lamp-testing bureau, presented by Wilson S. Howell, the chief of the testing bureau, were read and referred to the afternoon session for discussion.

The closing session was held on Thursday afternoon, when the reports referred from the previous session were fully discussed, and after electing officers for the ensuing year the convention adjourned.

The following is the list of officers elected:

President—Samuel Insull, Chicago.
Vice-president—R. R. Bowker, New York.
Secretary—Wilson S. Howell, New York.
Treasurer—W. S. Barstow, Brooklyn.

Executive committee—Charles L. Edgar, Boston; Alexander Dow, Detroit; George R. Stetson, New Bedford; J. W. Lieb, Jr., New York; Samuel Scovil, Cleveland.

Entertainment of Visitors.

Each day brought forth a surprise in the way of entertainment for visitors. Tally-ho parties were provided for the ladies on Tuesday and Wednesday morning, one being devoted to the American side and the other to the Canadian. They were largely attended and greatly enjoyed.

On Tuesday afternoon the entire party of members and visitors visited the power plant of the Cataract Construction company, and were taken in charge by Dr. Sellers and Messrs. Stillwell and Dunlap. The feature of construction that proved most impressive was the pit under the extension of the power house. Other features were also carefully examined and every detail was explained.

A visit to the observation tower and a trip on the inclined railway and Maid of the Mist completed the afternoon's entertainment.

Wednesday afternoon was devoted to an inspection of the Gorge and the Whirlpool Rapids. The party left the Cataract House at 2:30 o'clock, crossed the bridge to the Canadian side, where cars were waiting to carry the sight-seers to the battlefield of Chippewa. From this point they made the trip along the Canadian side to Lewiston, passing Brock's monument, the steel arch bridge, the new suspension bridge, the ruins of the first suspension bridge, the stone erected by the Prince of Wales marking the spot where General Brock fell, the battlefield of Queenstown Heights and the ruins of the house in which the first Canadian newspaper was printed. From the line of the Niagara Falls Park and Railway company splendid views of the points of interest along the river were had. Several stops were made for this purpose. The road passes through a fine country of vineyards and orchards. An amusing incident that enlivened the trip was the wild scramble for peaches that marked the arrival of the party at the first orchard. Some one signaled to stop the cars and immediately the train was deserted and the orchard taken by storm. A huge dog that had been on guard viewed the approach of the party for a moment and then, with a cry of alarm, turned and fled, leaving the attacking party in possession of the field.

At Lewiston a boat was taken across stream and the return to town made on the American side over the Great Gorge route. The trip is undoubtedly more impressive than that on the Canadian side, but the latter is very attractive and the inspection of the river is not complete without both experiences.

In the evening the most sensational feature of the week was presented, when the visitors were invited to witness the electrical illumination of the Whirlpool Rapids, described elsewhere in detail.

Agricultural Building. Machinery Building. Negro Building.

ELECTRICAL ILLUMINATION OF THE TENNESSEE CENTENNIAL EXPOSITION.

ELECTRICAL ILLUMINATION OF THE TENNESSEE CENTENNIAL EXPOSITION.—COMMERCE BUILDING.

Edison Convention Notes.

The attendance at the meetings was the largest that has yet been known in the history of the association.

Charles D. Shain, who accompanied the Chicago party to the Falls, was greeted heartily everywhere Mr. Shain, although no longer directly identified with the lighting business, is very popular with his old associates.

A conspicuous figure about the Cataract was Allen R. Foote, who will be remembered as a former secretary of the National Electric Light association. Mr. Foote is now living at Washington attending his numerous publications.

Many ladies attended the convention and enjoyed the hospitality of the association. John W. Howell was unremitting in his efforts to provide for the comfort and entertainment of the ladies, and he succeeded admirably in his efforts.

The programme was admirably arranged, and the plan of holding morning and evening meetings proved a very agreeable change from the experience of the National Electric Light association. At the June convention of the latter organization the visitors found it difficult to pass the evenings pleasantly. It proved a much better arrangement to devote the afternoon to social features

This year a press committee was appointed and such matter as was considered of general public interest, and the publication of which was not antagonistic to the interests of the members, was given out. Messrs. Dow, Edgar and Bowker prepared these reports, and their services were highly appreciated by the representatives of the electrical journals.

W. M. Habirshaw of New York constituted an unofficial entertainment committee for the Edison convention. Dr. Habirshaw's familiarity with Niagara Falls and the great work that is being done there brought his services into great demand. He was the guide, philosopher and friend of the visitors and evidently enjoyed extending hospitality as much as the recipients of his favor were benefited by kindness.

Martin J. Insull, accompanied by his wife, was the guest of his brother, Samuel Insull, during the convention. Martin Insull has not been in the electrical business as long as his brother, but he is displaying the same characteristics, and will undoubtedly gain a prominent place in the electrical world. He is a partner with Sargent & Lundy, electrical engineers of Chicago, and looks after the business of the concern. He has already established an excellent reputation as a business man.

It may seem rather strange to Chicagoans to find Alexander Dow numbered among the Edison men. When in Chicago Mr. Dow was the expert for the Brush company, and anyone who heard him extol the merits of the Brush apparatus could have no doubt of his sincere belief in the Brush doctrine. But times have changed, and now Mr. Dow, who is with the Detroit Edison company, is just as enthusiastic and to all appearances as firm a believer in Edison as he was formerly a devoted follower of Brush.

Considerable surprise was manifested on Wednesday evening by the appearance of Silvanus P. Thompson at the Cataract House, and it was jokingly suggested that the eminent English electrician had come over to attend the Edison convention. He did not remain long at Niagara Falls, however, but while there met several old friends. He had been in the West since the Toronto meeting of the British Association, and was on his way to New York. He expressed himself as well pleased with his American trip.

E. Lavens, general manager of the General Incandescent Arc Light company, who attended the Edison convention, related many interesting experiences. One of these, illustrating the difference between English methods and American practice, was an incident that came under his own observation, during a visit to England last summer. His attention was attracted by two men trimming arc lamps. They had a push-cart with a ladder upon it and went from lamp to lamp, one holding the ladder to keep it steady while the other climbed to the lamp and changed the carbons. Mr. Lavens noticed that they were very deliberate in their movements—fair examples of English conservatism—and he took occasion to preserve a record of their movements. From the time they left one lamp until they trimmed

the next and started for another, the average time consumed was 17 minutes. The result of this observation amply repaid the American visitor for the time he had spent in watching the movements of the English workingmen.

"One of the best things that I have read in a long time," remarked a member, "was the reference to a peculiarity of Luther Stieringer contained in Mr. Dyer's paper on electrical fixtures, which was printed in the current number of the Western Electrician. Mr. Dyer calls attention to the fact that Stieringer carried parts of an invention about in his pocket and stopped his friends on the street to talk about it. No matter where you meet Stieringer you will find him ready to talk about the latest thing out. Although he is not required to work as hard now as in those early days, he is just as much interested. He is certainly an enthusiastic and intelligent worker." Mr. Stieringer represented the New Orleans Edison company at the Niagara gathering, and acted as sergeant-at-arms during the convention.

President Insull tells many good stories of Edison, one of which will bear repeating here. Mr. Edison had been importuned by an old friend for a word of advice for a young man who was just entering life. At the time Edison was standing in the office of his laboratory at Orange, gazing abstractedly at a clock that never ran—a present, by the way, together with the other fittings of the place, which was furnished for him before he moved into the Orange establishment. While standing thus, plucking his eyebrows, as is Edison's habit when engrossed in deep thought, his friend said: "Just give him a word, or sentence that he can carry in his mind through life." Thus recalled by the voice of his friend, Edison said: "Tell him never to look at the clock." His companion greeted the remark as a jest, but those who are acquainted with the life and habits of the great inventor realize that it told the story of his life, and that it furnished the key to much of his phenomenal success. Edison may be said to have continued his experiments in every subject he investigated until his task was completed.

George A. Redman, who has been a regular attendant at the Edison conventions some time back, has not always been a believer in the Edison system. He was the first superintendent of the Brush company at Rochester, a pioneer in arc lighting, and he developed that company's business until it became a splendid property, and was absorbed by the Rochester Gas and Electric company, when the latter corporation acquired all the lighting plants of the Flower City. Mr. Redman was retained as general superintendent of the electrical department, with the large Edison plant among the stations he controlled. He has evidently become convinced that the Edison system possesses merit, for, on occasion at least, he is an ardent supporter of it. Mr. Redman is a member of the National Electric Light association, and has served upon the executive committee of that body for several years. He is also interested in the street railway system of Rochester. Before entering the lighting business Mr. Redman was local manager of the Western Union Telegraph company and one of the old telephone companies in the Flower City. He is widely known in every branch of the business.

There are differences of opinion among Edison engineers as well as ordinary mortals, and these gentlemen frequently engage in discussions as animated as those which occupied the attention of the advocates of the relative merits of direct and alternating systems in the early days. This week's meeting of Edison men was no exception, and the proceedings were enlivened by several lively, good-natured tilts. No record was kept of the discussions, of course, and the world will not enjoy the advantage which it might have gained had the expressions of this able body of engineers and managers been preserved for later consideration. However, a line or argument was started at Niagara which will be followed until the questions involved are settled, so far as such matters can be determined in a general way. Boston and Chicago disagreed, as might have been expected, owing to the fact that Mr. Ferguson and Mr. Edgar, both men of pronounced views, advocated the methods practiced in their respective cities, which happen to be different in many important details. Mr. Edgar has been an earnest advocate of the use of storage batteries in central stations, and he believes the experience of Boston proves their value as an auxiliary. On the other hand, Mr. Ferguson finds that the conditions in Chicago make the use of rotary current transformers advisable, and he has become a champion of sub-stations based on the employment of these machines. He found many followers and inclined others to his view. Another fruitful topic, as may be surmised from the report of the proceedings, was the subject of charging for current. This was one of the most valuable discussions of the meeting. It may be said that every paper presented was carefully prepared and showed a thorough knowledge of the subject. Moreover, they all dealt with live topics.

There are always plenty of smokers at convention time to accommodate those who do not retire early. On Tuesday evening several members who had had many years' experience spun yarns by the yard, some of them being of general interest. One story will be recalled by those who attended the Edison convention at Minneapolis several years ago. It had been reported, as usual, in advance that Mr. Edison would attend the meeting, and when the New York delegation arrived in Minneapolis the reporters for the local papers were on hand, eager to catch a glimpse of the great inventor. Edison had not accompanied the party, but one young and ambitious scribe refused to accept the statements of several members to whom he applied for information. It transpired later that someone had given this neophyte a pointer that Edison avoided publicity as much as possible, and had hurried from the train to the hotel before his presence was discovered. The young man accordingly haunted the rotunda and corridors of the West Hotel, and pestered the members of the association until someone realized what an excellent opportunity it was for a little fun. Several visitors were let into the secret, and finally it was arranged to have John Muir impersonate Edison. When the young man accosted the supposed inventor he found it difficult to overcome the diffidence and modesty of the great man. "Edison" was reticent when his work was the topic of conversation, which, by the way, was all one-sided for a time; then, when the first blush had disappeared, the young interviewer was loaded up. He was ambitious and careful in his work, and several times had statements repeated that he did not understand, and which, if printed, would have blasted the reputation of Edison or anybody else to whom they might have been attributed. Of course the interview never got into print, although it came pretty near being published, and, had it not been for the fact that the city editor of the paper had a personal friend among the members who assured him that the affair was a hoax, it would undoubtedly have been the talk of the country the following day. The young man who had afforded the boys so much amusement did not suffer because of this incident. He was amply repaid by getting several good stories that were not "killed," and making many friends among the members.

Members and Visitors.

Following is a list of the delegates and visitors in attendance at the Edison convention:

Abbott, John Jay, assistant to general superintendent, Chicago Edison company, Chicago, Ill.
Anthony, W. M., comptroller Chicago Edison company, Chicago, Ill.
Barstow, W. S., general superintendent Edison Electric Illuminating company, Brooklyn, N. Y.
Batcheler, Charles, New York.

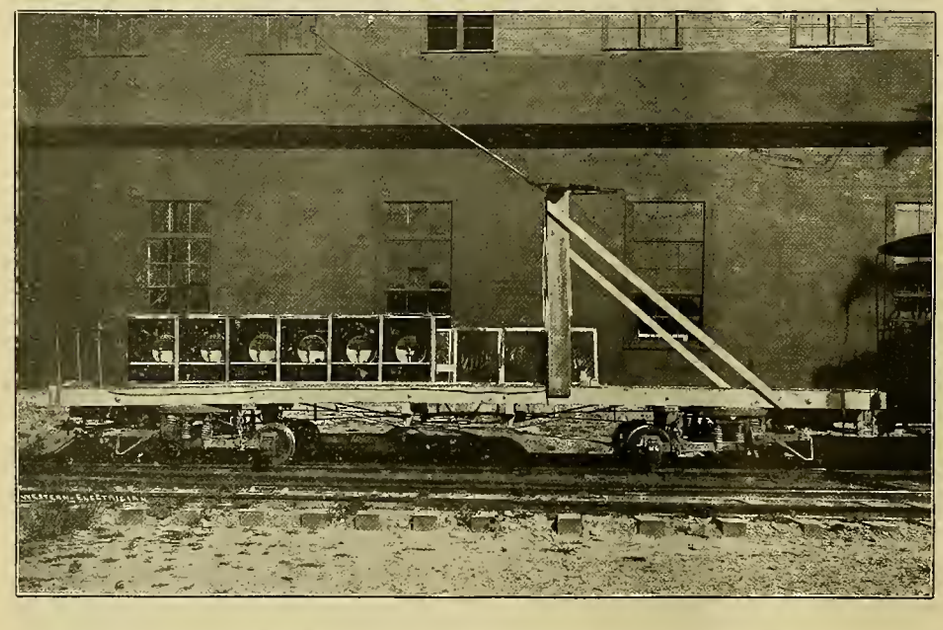
MEMBERS AND VISITORS AT THE EDISON CONVENTION, NIAGARA FALLS, SEPTEMBER 14, 1897.

Beal, M. A., secretary and treasurer Forest City Electric Light and Power company, Rockford, Ill.
Beale, William G., counsel of Chicago Edison company, Chicago, Ill.
Bowker, R. R., first vice-president Edison Electric Illuminating company, New York.
Chandler, William, Edison Sault Electric company, Sault Ste. Marie, Mich.
Clark, Wallace S., Scheuectady, N. Y.
Colby, J. S., treasurer and general manager Des Moines Edison Light company, Des Moines, Iowa.
Crider, J. S., Edison Electric Illuminating company, Cumberland, Md.
Davenport, George W., treasurer Electric Light and Power company, Syracuse, N. Y.
Dow, Alexander, general manger Edison Illuminating company, Detroit, Mich.
Edgar, H. T., New York.
Edgar, C. L., vice-president and general manager Edison Electric Illuminating company, Boston.
Ferguson, L. A., general superintendent Chicago Edison company, Chicago, Ill.
Field, A. W., secretary and manager Columbus Edison Electric Light company, Columbus, O.
Finn, George H., secretary, treasurer and general manager Edison Electric Light and Power company, St. Paul.
Francis, W. H., Edison Electric Illuminating company, Boston, Mass.
Girvin, Warren H., general manager Edison Light and Power company, Syracuse, N. Y.
Greene, S. D., General Electric company, Schenectady, N. Y.
Habirshaw, W. M., New York.
Hale, R. S., Boston, Mass.
Howell, John W., expert General Electric Lamp Works, Harrison, N. J.
Humbird, James T., Edison Electric Illuminating company, Cumberland, Md.
Insull, Martin J., Sargent & Lundy, Chicago, Ill.
Insull, Samuel, president Chicago Edison company, Chicago, Ill.
Johnson, W. H., secretary and manager Edison company, Philadelphia, Pa.
King, Charles G. Y., mechanical engineer Chicago Edison company, Chicago, Ill.
Knight, A. S., auditor Edison Electric Illuminating company, Boston, Mass.

Kruesi, John, General Electric company, Schenectady, N. Y.
Lavens, E., general manager Incandescent Arc Light company, New York.
Lieb, J. W., Jr., general manager Edison Electric Illuminating company of New York.
Magner, George P., treasurer Newport Illuminating company, Newport, R. I.
Martin, T. C., Electrical Engineer, New York.
McGhie, John, General Electric company, New York.
O'Hara, John B., Western Electrician, Chicago, Ill.
Pattison, Charles E., Edison Electric Illuminating company, Boston, Mass.
Perry, C. C., Indianapolis Electric Light and Power company, Indianapolis, Ind.
Post, Hoyt, director Edison Illuminating company, Detroit, Mich.; also director Edison Light company, Grand Rapids.
Price, Charles R., treasurer New Bedford Gas and Edison Light company, New Bedford, Mass.
Redman, George A., general superintendent electrical department, Rochester Gas and Electric company, Rochester, N. Y.
Robertson, A. M., secretary and general manager Minneapolis General Electric company, Minneapolis, Minn.
Scherck, Leon H., Edison Electric company, New Orleans, La.
Shaln, Charles D., New York.
Smith, August Leonard, president Appleton Electric Light and Power company, Appleton, Wis.
Smith, W. S., superintendent Toledo Consolidated Electric company, Toledo, O.
Stetson, George R., president New Bedford Gas and Edison Light company, New Bedford, Mass.
Stieringer, Luther, Edison Electric company, New Orleans, La.
Sunny, B. E., General Electric company, Chicago.
Wustenfeld, Christopher, manager Elgin City C. & A. Ry. Co., Elgin, Ill.

Illumination of the Whirl pool Rapids

One of the magnificent sights enjoyed by the members attending the convention of Edison companies at Niagara Falls was afforded by an experiment arranged between Superintendent J. K. Brooks of the Great Gorge route, Luther Stieringer and the General Electric company. Briefly, it was the illumination of the whirlpool rapids by powerful searchlights. The idea originated with Mr. Stieringer, whose experience with searchlight effects on moving waters, gained from the electric fountains at the World's Fair at Chicago, enabled him to gauge the probable success of this experiment. Mr. Brooks arranged the car and the lights and provided the current, while the General Electric company furnished the searchlights and colored screens. The illumination was merely in the nature of a trial demonstration of the feasibility of realizing Mr. Stieringer's idea, which comprehends ultimately the illumination of the whirlpool rapids nightly during the season on a very much larger and more substantial scale. The methods adopted in this instance were somewhat crude, owing to the shortness of time in which arrangements had to be made.



CAR WITH SEARCHLIGHTS FOR ILLUMINATION OF THE WHIRLPOOL RAPIDS.

Six standard General Electric searchlight lamps were employed. They were set in six plain wooden boxes painted dead black inside. In front of each arc lamp, attached to the back of the box, was a polished silvered reflector. The boxes were placed on one of the flat cars of the Great Gorge railway, and the lights were controlled by a rheostat, also on the car. A start was made from the Cataract House in special cars, under the immediate charge of Superintendent Brooks. Many of the party had no idea of what they were about to contemplate. Arrived opposite the point in the whirlpool rapids, where the movement is most turbulent, the lights on the cars were suddenly extinguished. The moon had not risen, and the Gorge was a huge cave paved with a hurrying, leaping mass of grayish water and roofed with the almost black sky. The scene was impressive.

The small switch on one of the uprights of the car was suddenly closed by Mr. Brooks. Instantaneously the beams of light, concentrated into one, flashed out upon the rapids. The effect thus produced evoked a gasp of admiration from the favored spectators. The intensity of the white light upon the masses of tumbling, roaring waters was more than magical. They seemed to be endowed with a new life, weaving and interweaving in white, fleecy foam and pale emerald overturn, curving under and over as they dashed down toward the whirlpool. It was a new view of the rapids, and conveyed, perhaps, a better idea of the force and violence of the current than can be gained under the light of day.

To endeavor to improve on this seemed an anticlimax, but Mr. Stieringer had another treat in store. He had provided a series of colored screens to see what effect colored beams would give to the water. The red screen was lowered in front of the reflectors, and the effect produced showed that the climax had not yet been reached with the pure white light. The water now assumed an almost blood-red hue, such as is found in the depths of a furnace of molten metal. The great masses of undercurrent moved onward a deep red, the leaping foam of a lighter hue, playing like the lambent flame over the solid water beneath. From the cars this burst of color in the inky blackness of the surroundings was weird. From the top of the gorge bank the effect was almost diabolical. In the words of one of the spectators, "had Dante witnessed this he had constructed another circle to his Inferno."

The lamps were left lighted during the return journey, and there was no part of the whirlpool rapids but was momentarily illuminated by the concentrated beam of white light.

Perhaps of all the varied entertainments provided for the members and guests, none evoked such expressions of satisfaction and admiration as this grand spectacle.

Street Railway Magnates of the Empire State.

The Street Railway association of the state of New York is an all-star combination, and its fifteenth annual meeting was attended by many prominent men. Is is evident from the class of men interested that street railway securities are considered pretty good investments in the Empire State. Of course the attendance at a state convention, even in New York, with all its pretensions, is necessarily rather small in comparison with that at the national gatherings of street railway and lighting organizations, but the members console themselves with the reflection that it is a very select body, and they are entitled to whatever comfort they may get out of the thought. It is certainly a fact that New York has many prominent street railway men, and they all seem to take a lively interest in the state organization. There is some rivalry between the cities in the interior of the state over honors, but it does not appear openly.

Binghamton has been honored with the presidency several times, although it is one of the smaller towns of the state. It is a very attractive place, and the corporation of which Mr. Rogers is the directing and controlling spirit has done much toward earning for the town the title it enjoys of being the Parlor City. The street railway company is an enterprising concern and it has provided the city and suburban districts with excellent service.

Next to the president the most important figure at this year's meeting was the Hon. W. Caryl Ely, the resident vice-president, upon whom devolved the task of making arrangements for the meeting and providing entertainment for the members and visitors. Mr. Ely is a lawyer of some prominence in the western part of the state, and he is well known to electric light men as well as in street railway circles. Members of the National Electric Light association who attended the mid-summer meeting of that body at Niagara in August, 1889, will recall his eloquent speech at the opening session. Mr. Ely must feel gratified now when he reflects that the predictions which he made for the future of Niagara power development have been fulfilled.

John N. Beckley of Rochester, who was also vice-president, is numbered among the most enthusiastic workers of the association. Mr. Beckley is an ex-president of the organization and he has on more than one occasion entertained that body in the Flower City. He boasts of having introduced the first complete electric street railway system in the Empire State. When he was a struggling young lawyer in Rochester, 12 or 15 years ago, the street railway service was furnished by bob-tail horse-cars and the passengers walked to the front of the car and deposited the fare in a box or "passed it up." While Mr. Beckley was occupying the position of city attorney the complaints against the Rochester City and Brighton Railway company, the old corporation, grew so loud that it was believed the time had come for bringing about a change. Mr. Beckley was the man who formed the syndicate, purchased the stock of Messrs. Barry, Ellwanger, Woodworth and others, and immediately set about reorganizing the property. An electrical system was substituted for old slow-going horse-cars and a wonderful change came over the town. Rochester assumed metropolitan airs at once and it has made a mighty effort to sustain these pretensions ever since. As a result it is one of the prettiest and cleanest cities in the country. Last year Mr. Beckley, who had been president of the Rochester Railway company since its formation in 1890, decided to retire from active management, and at the annual election in January Frederick Cook succeeded him. Mr Cook is interested in many large corporations in Rochester. He is president of a bank, a brewery, an insurance company and a race track, and he is one of the best natured of Rochester's many jolly Germans. Fred Cook, as everybody calls him down in York state, made his money himself and is proud of it. He started in life as a railroad hand and for several years was conductor on an emigrant train on the New York Central. He is respected and honored by his fellow townsmen and he enjoys the confidence of the people throughout the state, as was shown by his election as secretary of state over Col. Fred Grant. He has been offered many other political honors by the Democrats of that state, but he has been forced to decline them, as his private interests demand his entire attention.

T. J. Nicholl, who was the official representative of the Rochester Railway company at the convention, is an experienced street railway man. He is general manager of the Rochester corporation, and has had entire charge of the operation of the system during the last eight months. Mr. Nicholl is an old steam railroad man, and his experience in that line, supplemented by his more recent work in the management of electric roads, makes him an exceptionally valuable man for the Rochester company. His judgment in matters pertaining to street railway management is highly regarded by his associates.

The New York member of the executive committee, H. H. Vreeland, has the distinction of being at the head of one of the best street railway properties of the world, although in point of equipment it is now at the bottom of the list. This is not the fault of the company, however, but of the city government and the kickers, who seem to flourish and thrive and multiply in the city that considers it an honor to play second fiddle to London. However, the Metropolitan company is now preparing for an elaborate system of conduit electric railway. Mr. Vreeland hopes that the unenviable reputation he has had of being the last to make the change from horses to electric power will have advantages in giving him the benefit of others' experience. He stated recently that there were 6,000 men at work on the Fourth and Madison avenue line and that by next month electric cars would be in operation from Astor place to the Grand Central station. He said that the underground work from One Hundred and thirty-fifth street to Ninety-second street, which was begun on August 4th, was almost completed, and that by the first week in October it would be ready for use. "When we have done, the company will have expended from $10,000,000 to $15,000,000 in improving the transit facilities of the city and at least $1,000,000 in practically repaving 50 miles of streets."

Clinton L. Rossiter, Mr. Vreeland's neighbor, has gained the good-will of the Brooklyn populace by giving better service and putting a stop to the reckless manner of running motor cars on the lines controlled by the Brooklyn Railway company. Mr. Rossiter is rejoicing in the increased patronage that the company's system has lately enjoyed.

The biggest street railway man in the western end of the state is Henry M. Watson, president of the Buffalo Railway company. Mr. Watson had grave fears last year that the people of Buffalo had determined to walk or ride bicycles, so marked was the falling off in the patronage of the principal lines, but now a noticeable improvement has taken place and all is serene once more on the shores of Lake Erie. Mr. Watson has been president of the American Street Railway association, as has also H. H. Littell, the general manager of the Buffalo system —a distinction of which no other street railway company in the country can boast. The company is using Niagara power to operate a portion of its system.

An old-timer in association work is John W. Mc-

Namara, an experienced street railway man, who has contributed largely toward the development of the Albany system, of which he is general manager. His position and influence at the state capital have always been exerted in the interests of his associates throughout the state whenever their property has been attacked. This has been one of the most successful features of the state association, and the fact that adverse legislation has been headed off can be attributed largely to the personal efforts of Mr. McNamara.

Improvement in business has made the Troy City Railway company happy and has lifted a burden from the shoulders of the management. On September 10th a dividend of one per cent. was paid, the first that had been ordered since that of last December. Heretofore 1¼ per cent. has been the quarterly rate paid by this company, but the directors decided to cut off one-fourth per cent. and apply it to a sinking fund to take care of the $400,000 bonds of the company. President Cleminshaw, who represented the company at the convention, said that the prospects for improvement in business were certainly very favorable in the city of collars and cuffs.

New York Street Railway Association.

The street railway men opened their convention at the International Hotel, Niagara Falls, on Tuesday, September 14th, with a blare of trumpets. There was a large attendance, and it was found that a splendid list of papers had been prepared for the occasion. A number of distinguished visitors were present, including the street railroad commissioners of the state and their electrical expert. T. C. Pennington of Chicago, the secretary and treasurer of the American Street Railway association, was on hand to urge the members to attend the October meeting of the general body. A delegation from Dublin, Ireland, and Birmingham, England, attended the meeting and were greatly interested in the proceedings. There was also a large attendance of supply men.

President J. Tracy Rogers of Binghamton called the meeting to order, and on roll call it was found that the following-named gentlemen were in attendance:

Delegates of Street Railway Companies.

Boyle, John W., president Utica Belt Line Street Railroad, Utica.
Brewster, J. C., superintendent N. F. & S. B. R. R. Co., Niagara Falls.
Cahoon, J. B., general manager Elmira and Horseheads Railway company, Elmira.
Clark, J. P. E., general manager Binghamton Railroad company, Binghamton.
Cleminshaw, Charles, president Troy City Railway, Troy.
Cole, William W., West Side Railroad company, Elmira.
Cooper, H. S., Schenectady Railway company, Schenectady.
Danforth, R. E., Buffalo, Bellevue and Lancaster Railway company, Bellevue.
Deming, Peter C., superintendent Buffalo Railway company, Buffalo.
Ely, W. Caryl, president N. F. & Buffalo Ry. Co., Niagara Falls.
Evans, H. C., Nassau Electric Railroad, Brooklyn.
Fearey, Thomas H., Buffalo, N. Main Street and Tonawanda Railway company, Buffalo.
Havens, William E., superintendent Citizens' Street Railway company, Fishkill-on-Hudson.
Heller, W. H., Lewiston & Youngstown Frontier Railway, Lewiston.
Hill, Charles B., Niagara Falls and Suspension Bridge Railway, Niagara Falls.
Johnson, H. L., president Nassau Railroad, Brooklyn.
Johnson, Henry A., Metropolitan Street Railway company, New York.
Maloney, F. G., electrician Elmira and Horseheads Railway company, Elmira.
Marshall, C. K., N. F. & B. Ry., Niagara Falls.
McCabe, Ambrose P., Metropolitan Street Railroad company, New York.
McCormack, J. H., general superintendent Brooklyn Heights Railway company, Brooklyn.
McNamara, John W., Albany Railway company, Albany.
Moffitt, John H., Rapid Transit Railway company, Syracuse.
Mooney, F. P., C. & H. Traction company, Cortland.
Morgan, Godfrey, Buffalo, Main Street and Tonawanda Railway company, Tonawanda.
Newton, Henry S., Syracuse Rapid Transit Railway company, Syracuse.
Nicholl, T. J., general manager Rochester Railway company, Rochester.
O'Connor, Edmund, attorney of association, Binghamton.
Phillips, W., Niagara Falls Park and River railway, Niagara Falls, Ont.
Porter, B. W., Saratoga Traction company, No. 99 Cedar street, New York.
Porter, Alexander J., director N. F. & S. B. R. R. Co., Niagara Falls.
Rogers, G. T., president Binghamton Railroad company, Binghamton.
Seixas, E. F., Amsterdam Street Railway company, Amsterdam.
Sliney, George H., Nassau Railroad company, Brooklyn.
Smith, Charles H., superintendent Troy City Railway, Troy.
Stedman, J. H., Rochester Railway company, Rochester.
Story, C. B., Hoosick Railway company, Hoosick Falls.
Van Etten, Ames, Kingston City Railroad company, Rondout.
Van Horn, Burt, N. F. & B. Ry., Niagara Falls.
Watson, Henry M., president Buffalo Railway company, Buffalo.
Wheatly, W. W., secretary Brooklyn Heights Railroad company, Brooklyn.

Exhibitors and Visitors.

Adams, H. E., Central Electric company, Chicago, Ill.
Aeby, A. E., The Pennsylvania Steel Co., New York.
Allison, Giles S., St. Louis Register company, New York.
Anderson, Edgar P., Dublin United Tramways company, Dublin, Ireland.
Anderson, William, secretary and manager Dublin United Tramways company, Dublin, Ireland.
Baker, Frank M., railroad commissioner, Owego.
Barnes, C. R., inspector state railroad commission, Rochester, N. Y.
Beach, R. H., General Electric company, New York.
Beattie, T. Stoddard, Municipal Record and Advertiser, New York.
Beeton, S. Dick, Kerr & Co., Hove, Sussex, Eng.
Burns, C. J., contractor, Rochester.
Clark, William J., General Electric company, New York.
Cole, Ashley W., railroad commission, Albany.
Concanon, J. B., Dublin, Southampton, Barcelona and Tramway Union company, London, Eng.
Dickinson, Alfred, European Tramways, Birmingham, Eng.
Dunn, George W., railroad commission, Binghamton.
Estep, Frank A., president and treasurer R. D. Nuttall company, Allegheny, Pa.
Evans, H. C., The Johnson company, New York.
Fearey, Thomas H., General Electric company, Buffalo.
Flett, George, managing director, Dick, Kerr & Co., London.
Granger, J. A., New York Car Wheel Works, New York.
Haskell, G. W., J. G. Brill company, Philadelphia.
Holbrook, Percy, Weber Joint Manufacturing company, New York.
Jackson, George J., secretary National Conduit and Cable company, New York.
Lawless, E. J., American Car company, New York.
Long, E. T., Peckham Motor Truck and Wheel company, New York.
MacGovern, Frank, Rossiter, MacGovern & Co., New York.
Manson, George T., The Okonite company, New York.
McGhie, J., General Electric company, New York.
Morrell, Frank A., Sterling Supply and Manufacturing company, New York.
Morris, Elmer P., McGuire Manufacturing company, New York.
Murphy, J. F., Dublin Tramways, Dublin, Ireland.
Murphy, William Martin, Dublin and Belfast Tramway, Dublin, Ireland.
Peckham, E., president Peckham Truck company, New York.
Pennington, T. C., American Street Railway association, Chicago.
Polk, R. K., William Wharton, Jr., & Co., Philadelphia.
Potter, D. F., General Electric company, Buffalo.
Pugh, D. W., The Stephenson company, New York.
Randall, F. C., Christensen Engineering company, Hartford, Conn.
Ransom, H. N., Consolidated Car Heating company, Albany.
Read, John A., Tonawanda Railroad company, North Tonawanda.
Sharp, Edward P., manufacturers' agent, Buffalo.
Sheble, Franklin, Edison-Brown Rail Bond, Philadelphia.
Shippy, H. L., John A. Roebling's Sons company, New York.
Smith, Pemberton, New York Car Wheel Works, Buffalo.
Swan, G. W., John A. Roebling's Sons Co., New York.
Ten Broeck, William H., Diamond Truck and Car Gear company, Kingston.
Vosburgh, A. C., The New Process Rawhide company, Syracuse.
Vincent, C. A., vice-president the Ball-Wood company, New York.
Vosburgh, A. C., secretary and treasurer New Process Rawhide company, Syracuse, N. Y.
Waite, E. B., Tonawanda Railroad company, North Tonawanda.
Walsh, C. N., McIntosh, Seymour & Co., New York.
Watson, H. D., The E. P. Allis company, Milwaukee.
Wood, Charles N., R. D. Nuttall Co., Boston, Mass.

MEMBERS AND VISITORS AT THE CONVENTION OF THE NEW YORK STREET RAILWAY ASSOCIATION, NIAGARA FALLS, SEPTEMBER 14, 1897.

The press was represented as follows:

Crossman, T. E., stenographer, New York.
Kenfield, F. S., Street Railway Review, Chicago
Martin, T. C., Electrical Engineer, New York.
McGraw, James H., Street Railway Journal, New York.
O'Hara, J. E., Western Electrician, Chicago.
Parker, L. H., Electrical World, New York.
Price, Charles W., Electrical Review, New York.
Shain, Charles D., Electricity, New York.
Taylor, W. H., Street Railway Journal, New York.

The president opened the proceedings with the reading of his address, which is appended:

President Rogers' Address.

In behalf of the Street Railway Association of the State of New York it is my privilege to extend to you all a cordial welcome to this, our fifteenth annual convention.

It seems most fitting that we should meet here at Niagara, if for nothing more than to observe the object lesson which nature unfolds before us. The power exhibited here in nature's workshop is awe-inspiring, and could it be utilized would propel every street car in our state.

This year, which closes a decade of electrical traction, has been one of steady advancement on old lines; while no startling developments have been attained during the year, it seems almost impossible that the next 10 years should witness so many radical changes of benefit and advantage to us and the public.

The last year will long be remembered by those connected with street railroads, in many cases, as one of the most discouraging since the adoption of rapid transit. Trade and commerce have, we hope,

[*Continued on page 163.*]

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:
Suite 510 Marquette Building, CHICAGO.
TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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With the Niagara Falls convention number of the Western Electrician, dated June 12, 1897, this journal made a new record for itself both in circulation and advertising. Of this 100-page number 20,000 copies[1] were printed and circulated and the amount of full paid advertising matter carried was 8,643 square inches.

Beginning with the convention number of March 3, 1894, the record shows constant gains each year until in the present case the number of square inches of full paid advertising matter is more than double that of the 1894 number. The figures showing this unprecedented gain are given in the accompanying table:

Issue	Number of Advertising Pages.	Whole Number of Pages.	Square Inches of Paid Advertising Matter.
March 3, 1894....	40	56	4,145
February 23, 1895.	52	68	5,593
May 9, 1896.....	72	88	7,576
June 12, 1897.....	80	100	8,643

This constantly increasing patronage speaks eloquently of the influence and merit of this journal and of the confidence and respect which it commands throughout the country. It is pleasing recognition of the efforts that have been made in the interest of the entire fraternity.

Much of the space in this issue of the Western Electrician is devoted to reports of the two interesting conventions held in Niagara Falls this week—those of the Association of Edison Illuminating Companies and of the Street Railway Association of the State of New York. The former report is of unusual interest, as being the most complete ever given to the electrical public by this important but exclusive organization. President Insull's address is particularly notable in its allusions to the pleasant relations of the association and the General Electric company. Mr. Ferguson's paper, advocating the use of the alternating current for transmitting power from central to sub-stations in large cities, is also sure to attract attention.

Complaints are constantly being made of the damage the electric light is doing to the eyesight of those who work entirely by incandescent light. To determine the exact condition of affairs a novel line of experiment has been carried out by a Russian physician, to determine the wearying effect of several illuminants. He assumed that inasmuch as the act of winking was a natural method of resting the eye, it might be taken as a basis for comparative test; in fact, this has been, it is claimed, physiologically proven. In making the test in his own case, after repeated trials of reading 10 minutes each, he gives the following results: Winks per minute, with a candle, 6.8; with city gas, 2.8; with incandescent light, 1.8. It should be understood that to fulfill the best conditions the light should be perfectly steady—and, presumably, the experimenter as well. In this case all the requirements were met, unquestionably; otherwise, how could the learned subject of the czar record the fractional part of a wink?

The New York Tribune makes known its opinion that "if there is a worse abomination than 'bike'—meaning a bicycle—in current speech, it is 'shadowgraph'—meaning a picture made with Röntgen rays." "Shadowgraph" is certainly a badly constructed and unlovely word. "Radiograph" is little better. Early in the confusion of names incident to Prof. Röntgen's epoch-making discovery, the Western Electrician concluded that "sciagraph" was the most accurate and befitting appellation for a picture produced by the X-rays, and we note with pleasure that, among our contemporaries, this view is held by a constantly increasing number. It is but just to say that if the word was not actually coined by Prof. W. M. Stine of the Armour Institute, he was among the first to publicly champion its use.

While this subject is under consideration it may also be remarked that the term "X-ray" has about accomplished its mission as a stop-gap, and that the scientific word-builders should give us a more distinctive designation.

Commissioner Butterworth's request for an increase in the working force of the Patent Office, to keep the work of the bureau from falling hopelessly in arrears, seems to be entirely within the bounds of reason, and we trust that Congress will enact the necessary law at the coming session. On July 1st over 12,000 applications for patents were pending in the Patent Office—a larger number awaiting action than ever before enumerated in the annual reports of the commissioners. The number has been reduced somewhat since then, but still the congestion continues, and, as more patents are sought in prosperous times than in hard times, it promises to gradually increase unless some effectual remedy is applied. This remedy must not be found in a lowering of the standard of the examiners' work—the courts find enough to correct after the patents are issued as it is—but rather in increasing the force and affording the office all needful accommodations for its work. This is but the due of the great army of American inventors, who, by paying the large fees demanded, have made the Patent Office so much more than self-supporting that there is to-day in Uncle Sam's treasury a balance of over $5,000,000 to the credit of the Patent Office fund. Some of this money might be very advantageously expended to expedite the work of the department, so that the coveted parchments might be distributed to those entitled to them with no more delay than is actually necessary for careful examination.

Electrically propelled street-cars, introducing rapid transit, have entailed not a few changes in street railway law. Thus the Supreme Court of Louisiana holds that the "Stop, look and listen" rule developed in steam railroad practice must now be applied to street railways operated by electricity. It says that when street-cars ran slowly, and could be stopped within a distance of a few feet, the rule for the pedestrian to exercise his senses of sight and hearing, and to stop, look and listen, did not apply as it does to the electric cars. Greater prudence is required of a pedestrian who crosses a railway track of a steam or electric car in a city. It is his duty to exercise his senses of sight and hearing. Granted that the car complained of was running with speed, the court holds that that, of itself, was not negligence, if all needful care was exercised by the company. Nor does it consider that a dim headlight, or the fact that there was no ringing of the bell, relieved the pedestrian of his obligation to exercise ordinary care to avoid an injury, especially at a place not known as a regular public crossing. One who, in the nighttime, with full knowledge that a car may come at any moment behind him, attempts to cross an electric street railway track, the court continues, must use his senses to avoid an accident. On these grounds the court annulled and reversed a judgment for $10,000 against the railroad company, decreeing that the plaintiff's demand be rejected, because whenever the plaintiff's case shows any want of ordinary care his right to recover is thereby destroyed.

The bad accident on the Suburban electric railroad, near Chicago, serves to again direct attention to the need of train-dispatching service on long single-track electric railroads doing the suburban or cross-country transportation formerly performed, if furnished at all, by steam railroads. Some managers seem to think that street railway methods of operation are good enough for railroads of this class, but they are mistaken, as accidents too frequently prove. As this journal has frequently pointed out, the best methods of dispatching trains with safety and accuracy, as deduced by long years of experience on steam railroads, are none too good for electric railroads. It makes no sort of difference that the motive power is differently applied; the same vigilance and caution must be used in handling the trains of the newer system as were necessary in the old. It is easy enough to construct a telephone line along the road, with stations at suitable intervals; and the movements of the trains could be, by this means, reported to the central office by the trainmen themselves, who could receive running orders thereby, dependent on the movement of other trains or the exigency of the situation. If some such a system had been in use on the Suburban road, it would seem that the accident would have been avoided. In Ohio, where there are several comparatively long electric railroads, with single track, it is found to work well. Of course, if found necessary, a more elaborate system could be employed with station agents. There should certainly be some system better than that by which trains rush from one siding to another with no other guidance than the unaided judgment of the train crew.

1. State of Illinois, County of Cook—ss:
Thomas Jansen, being duly sworn, deposes and says that he is a resident of the city of Chicago, in the county of Cook and state of Illinois, and that he is the foreman of the printing department of the Electrician Publishing company, the publishers of the Western Electrician; that he was present at and superintended the printing of No. 24 of Vol. 20 of the Western Electrician, issued on June 12, 1897, and that there were printed by actual count 20,000 complete copies of said Western Electrician of the volume and number above specified. And further this affiant sayeth not.

THOMAS JANSEN.

Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

New York Street Railway Association.

[*Continued from page 161.*]

reached their lowest ebb. The bicycle is now our too successful competitor. It operates without franchise or track and pays no taxes. On the contrary, cinder paths are constructed, pavements laid down and in many cases pavements changed for its benefit. As a means of locomotion the bicycle has come to stay, but as a novelty it is being overdone and will share the fate of other novelties, and I believe has reached its zenith.

It has taken an almost superhuman effort during the past year on the part of a manager to keep the receipts of his road up and the operating expenses at a minimum. The populistic element among us has attacked us on every line, and it seems as if the accident lawyer has been more vigilant than ever before, if that were possible.

But the dawn of good times is here, and we have reason to believe we shall receive our share of good things to come. It is evident that investors believe in the future of street railroads, for during the past year there has been expended over $1,000,000 in Brooklyn alone in extensions, new equipment and track. There have been 1,900 miles of electric railroads built and 5,000 motor cars added to equipment in the United States, amounting to an investment of $35,000,000. Many new roads are being built in our state, connecting towns and villages with cities.

Notable improvements have been made recently in motor car construction, especially for the suburban and interurban roads; cars with all the comforts and conveniences of a steam passenger coach are now in operation on some lines.

The Legislature and the New York city officials have been dawdling with the question of rapid transit for a number of years, but whatever results have been accomplished in this direction may be attributed to the enterprise of the railroad companies. They have recently obtained the consent of the State Board of Railroad Commissioners to adopt electricity instead of horse power, over a distance covering 110 miles of track. This change involves an expenditure of $12,000,000, and I am informed that contracts have already been made for a large portion of the work.

Contracts have recently been closed between the Brooklyn Bridge trustees and the Brooklyn surface railroads by which the trolley roads of Brooklyn will extend their lines across the bridge. They propose to carry a passenger for a single five-cent fare from New York to any portion of Brooklyn reached by their lines, thereby saving the passenger the usual three-cent bridge charge and the annoyance of changing cars. This great improvement will cost the Brooklyn roads $500,000.

These improvements, costing millions of dollars, now about to be made in rapid transit for Greater New York cannot help but meet the approval of the public, and the advantages to be derived therefrom by the people of the metropolis are incalculable.

Nothing has been done within the last 10 years which has inured more to the benefit of the people of our state than the adoption of rapid transit and the consolidation of street railroads in cities, both large and small. Consolidation, which was at one time regarded as a menace to public welfare, is now universally recognized as redounding to its advantage.

Since the development of rapid transit the areas of our cities have extended to a marvelous extent. This rapid growth could not have been attained but for our street railroad systems and the adoption of electricity, furnishing a cheap, flexible and easily controlled motive power.

It is far within the bounds of truth to say that for every dollar invested in street railways another dollar has been given to the people through the resulting increase in property values alone. The street railways have handsomely repaid the public for their franchises.

The populistic element, with its plans for obtaining cheap fares and its ideas of municipal ownership, together with the high taxation of railroads, if allowed to be succesful will materially cripple street railways. Such dangerous methods, if adhered to, will wreck the property of investors in street railroads and turn over to duly appointed receivers the street railroad properties of our state. It will paralyze the splendid suburban growth, which is the magnificent payment being daily made to the people by the street railroads for whatever benefits they may have received. The American system of uniform fares is intended to stimulate this growth and to put the whole municipal area and its environs on an equality. It secures to the common people freedom from the tenement and a basis of calculation in changing of homes or places of labor. Free transfers and numerous other advantages have been given the people by the street railways without compulsion of the Legislature or municipalities.

The free transfer system has been so liberally adopted in this state and the margin of profit is already so small, that any legal reduction on fares, however little, would compel a complete abandonment of the far-sighted policy which is building up the cities of our state.

Our street railroads are earning less per car-mile than they earned under the horse-car period. This is due to several causes—the generous building for the future in suburbs, the increase of interurban traffic, and the generosity of the street railroad management in giving the people a better service by increase in car speed or greater frequency of cars.

Vested right is the last remedy we should seek in order to protect our franchise rights, but in many instances such measures must be resorted to in order to protect us against the clamor of the socialistic element. A number of decisions has been made of late which should be very gratifying to us.

Millions of dollars of street railway securities are held by the masses, and the Legislature and municipality cannot afford to allow this vested right or earning power to be interfered with. Our securities rank higher each year in the financial world, and are more acceptable as collateral for loans or investments.

It has been my experience that the majority of people appreciate, and are ready to reciprocate, any improvement or benefit extended to them. The roads with which I am connected have enjoyed the hearty co-operation of the public, the press and the officials of our city, and it is an obvious fact that the nearer we can consistently conform to the wants of the people the less trouble we shall have in getting what we ask of them.

More bills affecting street railroads were introduced in the Legislature last year than ever before, no doubt a majority of them at the request of constituents. Had they become laws and been put in operation, the public, as well as ourselves, would have suffered. We found the members ready to listen to our arguments and anxious to enact such laws as would be of service to the public good.

During the past year there has been organized an Association of Street Railroad Accountants. This association should have a cordial and hearty support. Next to the manager of a road, I consider the accountant the most important official; in fact, the successful manager must rely upon him largely as a guide in the management of the road. The manager and accountant must act in harmony in conducting the policy of the road, and in order to make any street railroad a success all heads of departments must be interested and act in unison.

An important advance made by the street railroads since the adoption of rapid transit is the improvement in character of employes. Better discipline is now maintained and more courtesy shown in catering to the public. As our business grows in technical and scientific requirements, it naturally attracts a class of men to whom there was formerly no call or inducement to enter its service. These are facts to be considered in selecting our employes.

The street railroad companies of this state are taking great interest in their employes. Nearly every road has a mutual benefit society or employes' club connected with it. Each has a plan agreeable to the ideas of the employes, and in nearly all instances the management has not only endorsed, but become a part of these societies. A number of roads have furnished clubrooms and other substantial assistance for them. We cannot take too much interest with the men connected with the operation of our roads.

The organization of mutual indemnity insurance companies for electric railways has been suggested as a protective measure against the prohibitive rates we are now charged. For years insurance companies have been experimenting with insurance upon street railroads. From the results obtained I should judge the business was not satisfactory. The insurance companies have either refused to write this class of risks or have established in many instances prohibitive rates. In a measure this may be the fault of the street railroad manager, who, feeling the responsibility in part removed, may have been more careless in the handling of his road. A number of roads still have low-rate policies, but they are based upon the record of the road's casualities. Not long since the rate for fire insurance was almost prohibitive, but I am pleased to state that we are now being insured at a fair rate, as compared with other business risks. Owing to the insurance regulations we are now debarred from the sale of power, which, in many cases, would be a large source of revenue, and under the present restrictions commercial lighting from the electric railway circuit will have to be confined to out of doors.

The rapid increase in the number and size of parks and pleasure resorts owned by street railway companies and operated by them as traffic promoters has been one of the striking developments which has accompanied the introduction of electricity as a motive power on street railroads. The general opinion of street railroad managers who have had experience in this direction is that such pleasure resorts properly conducted, with a judicious selection of amusements and entertainments, tend to increase the ordinary traffic of a road. But, in some cases, where the character and class of people to be served has not been studied, parks owned and operated by street railroad companies have not been successful adjuncts to the road. An amusement league for the interior cities of the state has been suggested. The idea is worthy of consideration, and, if properly handled, should be a saving and convenience to the roads in such cities.

The experiment of carrying United States mails has proved a success, and the postal car service on our roads is appreciated by the public and accepted by the government. New freight and express routes are being established, which operate not only as a convenience to the people, but as feeders to the steam roads.

The application of electricity to the existing steam roads is to-day a question of great importance to the practical railroad man. They are still in search of Aladdin's lamp, but they do not seem to have made any decided advance during the past year. We have, no doubt, made inroads into their local passenger receipts and probably will continue to do so. Our roads are so situated that in most instances we are at an advantage. We can operate at a much less cost than they, and our depots are at our patrons' doorsteps. The convenience and cheapness of our transportation recommends itself. I believe there is room for both of us, and, in a measure, the electric roads are a feeder to the steam roads, and the more closely they are allied the better for both.

Considerable progress has already been made in the utilization of the different water powers in which the state abounds, notably the Falls of Niagara, the St. Lawrence River, the Hudson River at Mechanicville, Oriskany Falls, near Utica, and several others which are worthy of mention. It has been suggested that the latent power now contained in the large culm piles of Northern Pennsylvania be also made available. The increased facilities resulting from new class of machinery and inventions for power transmission, the development of the alternating current, the multiphase system, and the creation of the induction motor have become actual facts, and practical long-distance power transmission is within our reach.

It is still a question as to whether the storage battery is becoming a practical factor in the operation of our roads, and whether at the present cost we can use it to advantage in our central stations and at the ends of our feeders, thereby assisting in maintaining the potential on the trolley lines. Compressed air and the many other powers now being tried may have some surprises in store for us. The results of these experiments and the inventions may be the beginning of a new era in the street railway world.

I congratulate you upon the financial and physical conditions of your roads, for notwithstanding the past year has been the most depressing in our history, it is the first year for some time during which a receiver has not been asked to take charge of some road of our state.

Many of the improvements I have referred to have been materially promoted by the intelligent discussions they have had at the meetings of our association. I am a believer in the importance and good results that can be accomplished by united action. I know from personal experience for the past two years that this association has been a tower of strength in protecting the legitimate rights of street railway interests of this state, and I hope that the same earnest and energetic support it received during that time will continue to be given it by all persons charged with the duty of looking after such properties.

The growth of our association and the interest taken in it by nearly all of the roads are subjects of congratulation. It is the desire of the management that the active men connected with our roads take more interest in the association, and especially the convention work.

I desire to thank you for the interest you have taken, also for your earnest co-operation in the affairs of the association and the prompt response which I have always been accorded. I sincerely believe in the future of the association, but it will become whatever we make it.

Thanking you for your kind attention, I wish you, one and all, a large share of the prosperity which I believe is in store for us.

General Business.

Secretary Robinson then read the report of the executive committee, which was received and approved.

The report of the treasurer showed the financial transactions of the year to be as follows:

Receipts	$7,637.62
Expenses	6,326.24
Balance	$1,361.38

The president announced that the next order of business was the reading and discussion of papers. He also said that a delegation of prominent tramway men from abroad was present, and in behalf of the association he extended to them a hearty welcome, and invited them to participate in the discussions. The first paper announced was on the subject "How Can We Increase the Efficiency of Employes?" by W. W. Wheatly of Brooklyn, N. Y.

The next paper was entitled "A Decade of Electric Railroad Development," by W. J. Clark of New York, after which the meeting adjourned.

The afternoon session was opened with a paper by Caryl D. Haskins of Boston, the subject being "Economical Influence of Accurate Measurements."

This was followed by a paper on "The Advantages of a Car Mileage Record," by T. J. Nicholl of Rochester, who said, however, that the paper was prepared by the company's mileage clerk, Charles J. Ingalls, and that any credit which may attach to it was certainly due to him.

"Facts and Fancies of Railroads," was the title of a paper by W. W. Cole of Elmira.

The next contribution was by H. S. Newton of Syracuse, on "Track Bonding; How Can We Obtain the Best Results?"

The president announced that the paper by C. L.

Rossiter of Brooklyn on "Advantages of Up-to-date Street Railroad Service; Why the Rate of Fares Should Not Be Reduced," was next on the programme. The secretary read Mr. Rossiter's paper.

J. P. E. Clark read the paper by Robert Dunning of Buffalo on "The Repair Shop."

This closed the afternoon session.

The banquet at the International on Tuesday evening was well attended and proved a delightful affair. The Hon. W. Caryl Ely of Niagara Falls acted as toastmaster and the following sentiments were responded to: "Welcome," Hon. Arthur C. Hastings; "The Empire State," Hon. James M. E. O'Grady; "The Niagara of To-day," Hon. Thomas V. Welch; "Street Railroads from the Consumers' Standpoint," John Kendrick Bangs; "Our Hosts," Hon. Edmund O'Connor; "The Railroad Commissioners," Ashley W. Cole; "Our Trans-Atlantic Visitors," William Murphy and J. B. Concannon; "The Association," John W. McNamara; "The Railway Press," J. H. McGraw; "The Ladies," J. H. Stedman; "The Supply Men of To-day," W. J. Clark.

A brief meeting was held on Wednesday morning, at which no business of importance was transacted, an adjournment being taken so that the delegates might make the trip to Lewiston. At three o'clock in the afternoon the meeting reconvened, and President Rogers appointed as the nominating committee Messrs. Moffitt, Robinson and McCormack.

The paper by H. H. Vreeland on "Municipal Ownership," was then read, but was not discussed as the president explained that it was the desire of the members to proceed with the reading of the papers in order to finish the programme.

H. S. Cooper then read a paper on "The Prevention of Accidents; the Best Method to Accomplish this End."

At this point J. P. E. Clark called attention to the lateness of the hour and the amount of business to be transacted, and suggested that the remaining papers be read by title, as the gentlemen who prepared them, he knew, would not be affronted. This was done. The papers referred to were: "Low Joints; How to Prevent Them," by C. L. L. Allen of Syracuse; "Street Car Wheels—Should They be Made Heavier?" by F. D. Russell, Rochester; "Construction and Maintenance of Car Bodies and Trucks," by Robert Dunning, Buffalo.

It was moved that a committee of five be appointed to confer with the railroad commissioners of the state for the purpose of framing a set of standard or uniform rules to govern the operation of street railroads of the state. Mr. Clark's motion was put and carried, and the president appointed H. H. Vreeland of New York, C. L. Rossiter and A. L. Johnson of Brooklyn, H. H. Littell of Buffalo and J. W. McNamara of Albany.

The election of officers took place on Wednesday afternoon, and resulted in the selection of the following-named gentlemen:

President—G. Tracy Rogers, president Binghamton Railroad company, Binghamton.

First vice-president—W. Caryl Ely, president Niagara Falls Electric Railway company, Niagara Falls.

Second vice-president—T. J. Nicholl, general manager Rochester Railway company, Rochester, N. Y.

Secretary and treasurer—Henry A. Robinson, vice-president Metropolitan Street Railway company, New York.

Executive committee—Herbert H. Vreeland, president Metropolitan Street Railway company, New York; John W. McNamara, treasurer and general manager The Albany Railway, Albany; Henry M. Watson, president Buffalo Railway company, Buffalo; Clinton L. Rossiter, president Brooklyn Heights Railroad company, Brooklyn, N. Y.

Mr. Rogers had expressed his determination not to serve another term, but he was persuaded to reconsider his decision. The only change in the list of officers was the substitution of Mr. Nicholl of Rochester for Mr. Beckley.

J. P. E. Clark said: "The Street Railway Association of the State of New York has two important functions, the protection of the rights of its members and the holding of the annual convention. I believe that the business of the meeting should not be made subservient to the entertainment. We appreciate the good time we have had, but the royal entertainment we have received has overwhelmed the business, and we have not been able to properly discuss the papers presented. I desire to suggest that in conducting the next annual meeting and subsequent conventions, that the business of the convention be concluded before the question of pleasure is considered." The suggestion was approved.

Mr. McNamara presented a resolution extending a vote of thanks to the Buffalo and Niagara Falls Electric Railway company, the Niagara Falls and Lewiston Railroad company, the Niagara Falls and Suspension Bridge Railway company, the Lewiston and Youngstown Frontier Railway company, the Niagara Falls Park and River Railroad company, the Niagara Falls and Clifton Suspension Bridge company, the Niagara River Navigation company, the Cataract Construction company, the Niagara Falls Hydraulic Power and Manufacturing company, the International Hotel company, and the local committees of arrangement and reception, for their courtesies and the arrangements which they made for the entertainment of the delegates and others at the meeting. It was adopted unanimously. This closed the Niagara Falls meeting, which was one of the most successful in the history of the organization.

The next place of meeting will be Brooklyn.

Street Railway Convention Notes.

T. C. Penington, secretary and treasurer of the American Street Railway association, made arrangements during his visit to have the exhibition space for the October meeting still further enlarged. He has secured 8,000 feet additional space for exhibitors.

Railroad Commissioners Baker, Cole and Dunn were on hand to urge the operating companies to take measures to prevent accidents on their lines. The question of providing fenders was thoroughly discussed, informally, and many influential members displayed a willingness to co-operate with the commission.

Aside from the banquet, the leading features of the entertainment of the Street Railway association were the ball with which the meeting closed, and several trips about Niagara which were greatly enjoyed by all. The general entertainment arranged by the local committee included an inspection of the plants of the Niagara Falls Hydraulic Power and Manufacturing company, the Niagara Falls Power company, and a trip to the New York state reservation and islands, rides over the several picturesque railways in the vicinity, including a trip over the Gorge road. On Thursday morning the entire party was conveyed to Buffalo in special cars of the Buffalo and Niagara Falls Electric Railway company, by the Niagara Falls and Suspension Bridge Railway company and the Buffalo Railroad company, closing a very satisfactory meeting.

The government of New York boasts of a state electrician. The office is under the State Railroad commisison and was created last year because of the general use of electricity for street railway purposes. The first person appointed to the position was Charles R. Barnes of Rochester, who has been engaged in electrical work since his boyhood. Mr. Barnes began life as a telegraph operator, but pounding a key at a crossroads telegraph office was not an ideal existence, so he selected Rochester as the scene of his operations. His advancement in public service was rapid. First he was given charge of the fire-alarm system, and to this was soon added a police telephone service. Later, when electric lighting and electric railways were introduced, Superintendent Barnes' office assumed greater importance and he was raised to the dignity of city electrician. When the time came for the appointment of a state electrician, George W. Aldridge, now state superintendent of public works and formerly chairman of the Executive Board of Rochester, under whom Mr. Barnes had served for several years, saw that his old friend was not forgotten. It must be said of Mr. Barnes that he is well qualified for his position. He is a close student of electrical matters and has kept in touch with the advancement in the electrical field; he is progressive and capable and is one of the most widely known men in the electrical fraternity. It was under Mr. Barnes' supervision that the tests were made of the electrical towing of canal boats at Rochester and Tonawanda.

Convention Shop Talk.

Charles T. Chapin of Rochester represented the Rochester Car Wheel Works at the Street Railway convention. Mr. Chapin has grown up in the car wheel business, and is thoroughly well acquainted with the details of manufacture.

The Peckham Motor Truck and Wheel company of New York had a model on exhibition in the rotunda of the International, which was carefully examined by the delegates. It was equipped with General Electric motors. The company also distributed circulars calling attention to the advantages of the special features of design and construction of its trucks.

The Bergmann long life arc lamp for constant-potential direct current circuits was the principal feature of the exhibition of the General Incandescent Arc Light company of New York. This lamp will burn from 100 to 150 hours with one set of carbons, and operate with a potential of about 80 volts across the arc. It is provided with a resistance mounted on the lamp, and is to be connected in multiple on circuits of 100 to 120 volts, provision being made in the resistance for this range of variation in voltage. The advantages claimed for these lamps are economy, safety, cleanliness and steadiness. Each lamp is separately controllable, the light is evenly diffused, and casts no shadows, and the current consumed at all times remains practically the same, whether at the striking of the arc, at feeding, or between. For circuits of 200 to 240 volts, they can be connected two in series; for circuits of 500 to 600 volts, four or five in series. A special winding, however, is required for two in series, and a special winding and cut-out for three or more in series, The company also showed switches for railway circuits and other devices. The company showed in operation an automatic self-winding clock switch, adapted to cut lamps in and out of circuit at a predetermined time each day. A double and a single-throw switch for railway circuits of 500 volts comprised another feature. Low-tension single and double-break switches, voltmeter switches, two and three-pole switches, were also shown. These devices attracted considerable attention among street railway men as well as the Edison men.

The Keystone arc light ground detector was the special attraction of the exhibit of Elmer P. Morris of New York. It is claimed for this apparatus that it combines in one instrument a voltmeter giving the actual voltage of each circuit, or the total voltage of the generator, and consequently the number of lamps burning, and a ground detector which will indicate a ground, determine its character and location. It will indicate the character of the ground, its resistance, and its location on the line by taking three readings and equating them in simple formulæ. It can be used when the circuit is "alive," thus giving results under working conditions. It replaces a cable testing set which has proved extremely unsatisfactory owing to the many microphone contacts in circuit. It is self-contained, well made, accurate, reliable, dead-beat, unaffected by external fields or changes in temperature, easy and safe to manipulate. In connection with a set of switches and a battery of cells, or an ordinary incandescent circuit, it can be used to test the conductivity of the line, and the resistance from line to earth during the day, and for this purpose will be found much easier to handle, more accurate in results, and quicker in action than any galvanometer and bridge method. A trial of 30 days is the condition upon which the instrument is offered to responsible station managers. Mr. Morris represented the Point Marion Manufacturing company, cross-arms, pins, poles and electrical molding; the Bradford Belting company, Monarch insulating paint; Hemingray Glass company, insulators; McGuire Manufacturing company, trucks; Garton-Daniels Electric company, lightning arresters; Electric Railway Equipment company and Hope Electric Appliance company.

The General Electric company was represented at the convention of Edison Electric Illuminating companies by S. Dana Greene, H. W. Darling, John Kruesi, G. T. Hughes, M. K. Eyre, A. D. Page, John W. Howell, C. D. Haskins, F. M. Kimball, S. B. Payne, W. S. Andrews, W. S. Clark and J. McGhie. In one of the rooms of the Cataract House, directly behind the convention hall, the company made an exhibit especially for the Edison people. Upon a switchboard were mounted examples of their incline coil instruments, including the edgewise instrument for feeder board service, a large "G 2" astatic ammeter for recording the total output of stations and calibrated to 2,000 amperes and a direct current astatic ammeter. A sample of the new Thomson recording wattmeter, especially designed for use by Edison Electric Illuminating companies, was also shown, as well as a lamp inspector's indicating wattmeter. Upon a table were laid samples of the new porcelain cut-outs developed by the General Electric company, sections of its wires and cables and examples of underground junction boxes and distribution boxes. To explain the manufacture of type "H" transformer there were shown the component parts of a transformer in course of manufacture. The exhibit also comprised samples of the single solenoid arc lamp and of the lately developed and very successful alternating current enclosed arc lamp. The exhibit was completed by two one horse power motors, one for 500 volt and the other for 220 volt circuits. The room was hung with the diplomas which the company has taken at the different expositions and photographs of some of its more important works. A full supply of literature was provided for the use of the delegates. For the Street Railway association the company made no exhibit. It was represented by W. C. Clark, the manager of its railway department, and R. H. Beach.

Electromania at Niagara Falls.

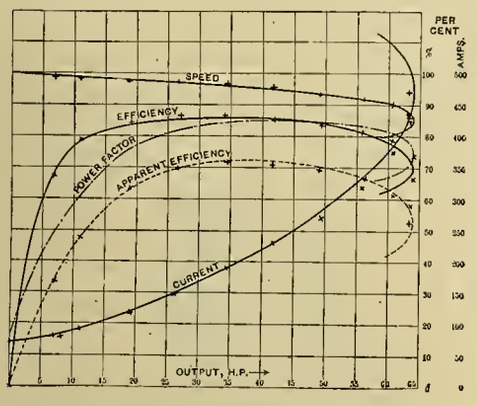
The visitor to Niagara Falls cannot fail to be impressed by the evidence on every hand of the prevailing epidemic of electromania in the most aggravated form. The entire community seems to be afflicted, and at present there seems to be no choice but to accept the situation and permit the disease to run its course. Electromania has manifested itself in many forms and places, entirely distinct and wholly different. For instance, the main thoroughfare of the town contains the "Electric City Bank" and an establishment of "electricians and keyfitters." There is an "electric bicycle works" across from the International, and an "electric stable" not far away. An investigation failed to disclose any electric vehicles, however. Almost every form of industry at the Falls has an establishment known as "electric" or "electricity," the barber-shops and bakers included, and the fad is so terribly overdone as to be supremely ridiculous. However, in spite of this devotion to electricity and all the boasted advantages the Falls has derived from the electrical development there, the Cataract House management has not shown sufficient enterprise to have the building electrically lighted, and the people of the town are informed of the hour for beginning their daily toil by the blowing of numerous whistles, all indicating that there is yet much to be done in Niagara as well as in the transmission of power to Buffalo.

Precision of Electrical Engineering.

By Francis B. Crocker.

Part II.

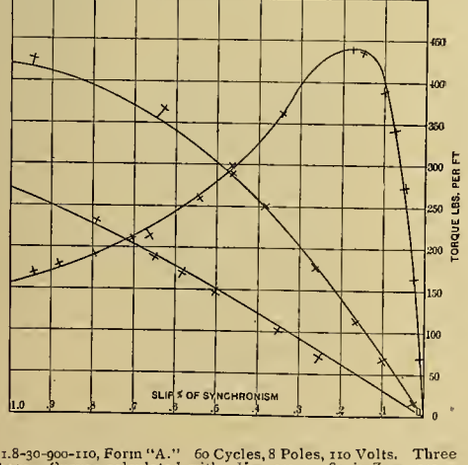
The paper on "The Alternating Current Induction Motor," presented by Vice-president Charles P. Steinmetz at this meeting of the Institute, affords an excellent example of the marvelous precision of electrical engineering. In Figs. 1 and 2, two curves are shown which give the efficiency, speed, power factor and other characteristics of a three-phase induction motor under various conditions. These curves were all predetermined by calculation. In the same figures the results obtained by actual test



1-8-30-900-110, Form "A." 60 Cycles, 8 Poles, 110 Volts. Three Phase. Curves calculated with: $Y = .045 + .384\,j$; $Z_0 = .045 - .124\,j$; $Z_1 = .041 - .124\,j$. Friction: 510 Watts at Synchronism. Observed by Test: ×.

FIG. 1. PRECISION OF ELECTRICAL ENGINEERING.

are also marked by small crosses. The agreement in all cases is so close that curves plotted from the actual results of tests would practically coincide with those predicted by calculation. This is all the more remarkable when it is remembered that the three-phase motor is one of the newest of electrical machines, and is a difficult problem from a theoretical standpoint. It has long been possible in designing direct current machinery to predetermine the results with almost as great accuracy as that shown in the curves of Mr. Steinmetz, but, of course, that is a much older problem. Nevertheless, the predetermination of results in direct current machinery is fully as difficult as in the case of alternating current apparatus, because permeability is the most doubtful factor in such calculations and is especially so at the high flux densities used in the former. It is to be observed, however, that any error in the permeability data can be corrected by increasing or decreasing the ampere-turns on the field magnet. This is easily accomplished by providing five or 10 per cent. greater magneto-motive force than the calculations require, which may be reduced, if necessary, by the introduction of resistance. Since the energy used for the field is a very small percentage of the total amount, it may be considerably varied without materially affecting the other factors in the machine.



1-8-30-900-110, Form "A." 60 Cycles, 8 Poles, 110 Volts. Three Phase. Curves calculated with: $Y = .045 + .384\,j$; $Z_0 = .045 - .124\,j$; $Z_1 = .041 - .124\,j$. Friction: 510 Watts at Synchronism. Observed by Test: ×.

FIG. 2. PRECISION OF ELECTRICAL ENGINEERING.

Sparking at the commutator brushes is an additional and by no means simple question which confronts the designer of direct-current apparatus. I remember, however, being informed by Mr. Gano S. Dunn several years ago that he had found by experience in many cases that the efficiency of a direct current dynamo or motor can be predetermined from the drawings before the machine is built, within a fraction of one per cent.; in fact, he relied more upon his calculations than upon an actual test of the completed machine, even when performed by skilled men. In one case the calculated efficiency was 93 per cent. and the result obtained by test was 92.7 per cent., and in another case the total flux was found to be 1.38 per cent. greater than the computed value. This agreement is somewhat closer than is found in everyday practice, but is not accidental and can usually be approximated by careful work.

We naturally suppose ourselves to be familiar with mechanical energy and heat; but as soon as we convert these well-known forms or energy into that extremely subtle and mysterious agent—electricity—it immediately becomes far more definite and convenient to control, measure, transmit and utilize. In becoming intangible, it forthwith acts as the most reliable and matter-of-fact tool in the hands of those familiar with it. For example, the quickest, neatest and most exact method of making a test of mechanical friction, or the power required in any given case, is by the use of an electric motor. In this way, for example, we can determine the friction of different bearings or lubricating oils under various conditions of pressure and speed, or the power consumed by fans, pumps and other machines.

Quite a striking example of the possibilities of electrical measurement is the determination of the electromotive force of a dynamo machine without running it, which I saw successfully carried out more than 10 years ago. All that is necessary is to measure the torque exerted by the machine with a given current in its armature. This may be accomplished by simply clamping a stick of wood to the pulley and weighing the pull at a given radius by means of a spring balance. If the same machine were run as a dynamo and had no losses, it follows that

$$\frac{E\,I}{746} = \frac{2\,\pi\,r\,S\,P}{33{,}000}$$

whence

$$E = \frac{r\,S\,P}{7.04\,I},$$

in which r is the radius at which the pull is measured, S is the speed in revolutions per minute at which the dynamo is to be run, P is the pull in pounds at the given radius and C is the current in amperes. The field strength is supposed to remain the same. This method is correct whatever the efficiency of the machine may be. The electrical and magnetic losses due to the C^2R effect in armature, field current, eddy currents and hysteresis do not enter this problem. Even the mechanical losses arising from friction of bearings, brushes, etc., may be eliminated by measuring the pull plus the friction and then minus the friction, the actual pull being one-half the sum of these two results. The effect of friction may also be gotten rid of by tapping the shaft when the measurement is made. It certainly strikes one as strange that electromotive force, which depends upon cutting lines of force, can be determined while the machine is standing still.

In electro-chemistry and electro-metallurgy quantitative relations are particularly precise. The ampere being defined as the current which deposits .001118 gramme of silver per second, the weight of any other substance is, by Faraday's laws, proportional simply to its chemical equivalent. This definition eliminates any error in passing from the electrical to the chemical data, or vice versa. The volt is also defined electro-chemically in terms of the electromotive force of a Clark cell.

The author presented before the Institute, in May, 1888, a paper on "The Possibilities and Limitations of Chemical Generators of Electricity,"[1] in which the weights of materials, electromotive force and other data were given for various voltaic combinations. Some of the figures were obtained by experiment and some by calculation. The paper also gives the electromotive force produced by combinations of 13 of the most important metals, with chlorine, bromine and iodine, respectively. The average difference between the calculated and tested values was less than one-tenth of a volt. Even this small error is practically eliminated when the results are corrected by the equation of Helmholtz, that is, by adding the quantity $\pm T\frac{d\,E}{d\,T}$, in which T is the absolute temperature and E is the electromotive force of the cell. Since the weights of materials liberated or consumed by a given current in a given time can be definitely predetermined and the voltage due to a certain chemical combination can also be accurately calculated, almost any problem in electro-chemistry or electro-metallurgy is susceptible of being quite easily and correctly solved.

That branch of electro-chemistry and metallurgy which employs electrical heating methods is also very definite, the exact amount of heat in gramme-degrees produced by an electric current being always given by the simple expression, $.24I^2R$, or $.24EI$.

In support of the proposition advanced in the title of this address, I am able to produce most interesting personal testimony. Mr. Edison and Mr. Tesla have independently expressed to me their opinion that electrical knowledge had become so definite and general that almost anyone could apply it, and comparatively little opportunity was left for invention. They believed that chemistry and thermodynamics were far more uncertain and therefore offered a much better field for improvement. These views were expressed several years ago, and subsequent events have shown that they contain a great deal of truth. It is a fact that electrical engineering has advanced along the lines laid down by these and other great inventors, and it is also true that much of the work has been done by the rank and file of the profession. The trails blazed by the pioneers have since become broad highways with many branching roads, built for the most part by common workmen. On the other hand, the discovery of the Röntgen ray has since been made; and both of these investigators have given much valuable time to it. It would seem, therefore, that the electrical principles and laws of to-day are true for all time, and afford a firm foundation for unlimited future progress, but that there are also many additional facts yet to be discovered that are well worthy of the efforts of the greatest genius.

In conclusion, the following quotation from the preface of Maxwell's great work on "Electricity and Magnetism" is appropriate: "The important applications of electro-magnetism to telegraphy have also reacted on pure science by giving a commercial value to accurate electrical measurements, and by affording to electricians the use of apparatus on a scale which greatly transcends that of an ordinary laboratory. The consequences of this demand for electrical knowledge and of these experimental opportunities for acquiring it have been already very great, both in stimulating the energies of advanced electricians and in diffusing among practical men a degree of accurate knowledge which is likely to conduce to the general scientific progress of the whole engineering profession."

These words were written in 1873, and yet they show strong confidence in the accuracy of electrical methods and full appreciation of the close relationship between electrical science and engineering, as well as their beneficial effects upon each other. At that time the telegraph was the only practical application of electricity. What language would express Maxwell's wonder if he were alive to-day!

1. Transactions, vol. v., p. 227.

Economy in Distribution of Electrical Energy.[1]

By Louis A. Ferguson.

Ever since the advent of the Edison central station for the distribution of electrical energy for lighting and power work, it has been the universal practice among the designing engineers of both the parent company and the local companies to confine themselves almost exclusively to the use of the direct current for both transmission and distribution.

Following this idea, it has been customary in the development of the lighting and power business of a large city to erect the original central station in the heart of the business district, laying an Edison underground network in that section and supplying it by feeders from the station.

With the successful lighting of the business district a demand is created for the electric light in the residence portion of the city, and to supply this the same method is followed as has been employed in the down-town district. Another steam plant must be erected at a central point and the territory covered by a network of underground conductors. Other districts are covered in the same way, until three, four and sometimes five steam stations are generating and supplying electricity to the several portions of the city; in some cases each supplying its own respective district and in others all stations delivering energy into one general network of conductors, covering the whole territory. It has been the practice in some cities to connect the bus-bars of two or more stations by means of direct current tie lines; in some cases the tie lines being used to send current from one station to the other to assist at the time of maximum load, or to charge storage batteries, or even to furnish the entire output during hours of minimum load in the territory supplied at other hours by a generating station.

In all cities of moderate size or considerable importance the service is furnished 24 hours every day in the year, therefore the cost per kilowatt-hour of operating in the stations having a small load factor will be very high, especially during the hours of minimum load, which is often 16 or 18 hours each day. This has been realized for some time, and many methods have been suggested and employed to reduce the cost of operating the smaller stations in the large cities.

We have all listened to the arguments in favor of the use of storage batteries in conjunction with the steam plant in these secondary stations, and several companies have employed them.

Some of us are using the direct current tie line from the main station to the secondary station to supply the entire output for the secondary territory during the greater portion of the day, operating the secondary stations as a steam plant from dusk until midnight only.

In Boston a storage battery sub-station supplies the residence portion, the battery being charged from the network during the time of minimum load, and in that city also a tie line connects the main station in Atlantic avenue with the Head Place station, charging a battery in the latter station and also feeding the underground system. The direct current tie line is economical and useful for carrying during the minimum hours the entire output of a residence district station or other station having a small load factor, when the distance between the two stations is not so great that the loss of energy in transmission and the interest and depreciation on the cost of the tie line will counterbalance the saving effected by shutting down the residence district station, but when the length of the direct current tie line is very long it then becomes

1. Read before the Association of Edison Illuminating Companies, at Niagara Falls, September 14, 1897.

uneconomical, owing to the excessive loss of energy in transmission. The pressure curve of a tie-line-fed sub-station whose underground network is not interconnected with the network supplied by the main station will be a very bad one, owing to the fluctuations of pressure due to ordinary variations in load, and more especially so if the load on the sub-station be even slightly unbalanced, which condition causes an excessive drop on the neutral of the tie line.

If, however, the underground network of the main station and the sub-station be interconnected and the tie line between the station bus-bars be used only to take such a portion of the sub-station output as will be necessary to give the desired pressure at the sub-station bus-bar, then the pressure curve of the sub-station will, without doubt, equal in regularity that of the main station, and the use of the tie line under this method will be economical and satisfactory.

While direct current tie lines between stations over two miles apart are useful at times of maximum load and in cases of emergency, this method is not the most economical for shutting down the sub-station under the ordinary conditions existing in large cities, even when storage batteries are employed in the sub-station.

It has been my belief for several years that the day has passed when we should erect steam generating stations distributed in the various sections of our large cities, and I feel confident that the the greatest and most profitable development in the lighting and power industry will be effected by intelligent combination of the alternating and the direct current, the former being used for transmission and the latter for distribution. I think it is generally conceded by all fair-minded engineers in America, experienced in central station work, that, despite all the advance in alternating current work in recent years, there has not yet been devised a system of alternating current distribution which possesses the advantages and simplicity of the three-wire direct current system for cities of moderate or large size. This being true, the underground system will remain as it is, and any increase in economy of operation must come from the abandonment of steam generating stations, except one, or possibly two main stations located on the water front, where multiple expansion condensing engines can be employed and cheap fuel may be obtained. The supplying of the business district will be from the main station by means of the three-wire direct current system if the distance from the station to the electrical center of distribution be less than, say, one mile. The remaining two, three or more stations, as the case may be, which formerly supplied the outlying territory will be abandoned as steam generating plants and will become simply sub-stations, receiving their electrical energy from the main station by means of three-phase alternating current transmission.

Under conditions where the main station is within a mile of the electrical center of the business district and the principal output is furnished by the three-wire system, there will be three methods of supplying the sub-stations, the apparatus in the sub-stations remaining the same in each case:

First.—In the main station we may install three-phase alternating current generators in suitable units to meet the conditions, the combined capacity being sufficient to take care of the entire output of all of the sub-stations. These generators should be built with rotating field and stationary armature and wound for the voltage of the line transmission, which should be from 2,000 to 6,000 volts.

In each sub-station there should be stationary transformers wound to reduce the pressure from that of the line to about 80 volts. The secondaries of these transformers in sets of three should then be connected to rotary current transformers in units of proper size to suit the conditions of the load in the sub-stations. The rotaries should be arranged in pairs, each rotary having an independent set of stationary transformers, and having the direct current side connected to the bus-bars of sub-stations on the three-wire plan. They will take the alternating current from the line, convert it to direct current at from 115 to 130 volts and deliver it to the bus-bars for distribution, giving to the customer direct current as formerly supplied by the Edison dynamos. This method is an exceedingly efficient one, and assuming that the efficiency of the alternating current generators in the main station is equal to that of the original Edison dynamos in sub-stations, which is very conservative, then the efficiency of the system from the switchboard in the main station to the switchboard in the sub-station will be from 84 to 86 per cent., based upon the following efficiency in apparatus: Rotary transformers, 91 per cent.; stationary transformers, 97½ per cent.; line loss, three to five per cent.

The Edison Electric Illuminating company of Brooklyn has adopted this method of distribution for development of new outlying territory, and is now installing apparatus on a large scale.

Second—The second method, though apparently not as efficient as that just described, when the apparatus is considered by itself under full load, will be found exceedingly useful in developing new territory and for additions to existing plant, and may yet, when all things are considered, prove nearly as efficient as the first method.

Instead of installing in the main station three-phase alternating current generators for the express purpose of delivering energy to the sub-stations, we may install in the main stations rotary current transformers so wound that their direct current sides may be connected to the positive and negative bus-bars of the main station, and operating conversely to the manner of operating rotaries in the sub-station. They will then take direct current from the main station bus-bars, convert it to three-phase alternating and send it through stationary step-up transformers which will raise the pressure to the desired voltage required for line transmission. The apparatus in the sub-station will be exactly the same as that described in the first method. With this second method we have the advantage of only one kind of generating apparatus in the main station, all direct current on the three-wire plan, and, further, all current required by the converse rotary to supply the sub-station transmission will be obtained from the Edison generators in the main station, thus loading them and their engines and increasing their efficiency of operation. This method is being employed by the Chicago Edison company temporarily, although the apparatus was originally built for the third method, which I am about to describe, and which will ultimately be adopted by that company for all its sub-station work. The apparent efficiency of the second method is 75 per cent., considering the losses in apparatus and line by themselves and not crediting the advantages gained by additional loading of engines and dynamos in the main station.

Third—The third method combines all the advantages of the first and second methods and has none of their disadvantages. The main station in this case is the same as before, having dynamos operated on the three-wire system.

Instead of the three-phase generator, as mentioned in the first method, we will install generators designed and built to give three-phase alternating current and direct current at the same time, in any quantities desired, up to the capacity of the machines. These generators will be practically power driven rotary current transformers and may be directly coupled to the engine or belted if preferred. They will furnish three-phase alternating current to the sub-station transmission line through step-up transformers in quantities sufficient to operate the sub-station, and the balance of their output may be furnished at the same time in direct current to the three-wire bus-bars of the main station. As the demand at the sub-station increases, the quantity of alternating current delivered by the special generators will increase and the quantity of direct current furnished to the bus-bars will decrease correspondingly, until finally, when the time of maximum load has been reached in the sub-station, the generators will be working at their full capacity as three-phase alternators and will be disconnected from the direct current bus-bars.

The efficiency of this method, from the main station switchboard to sub-station switchboard, is from 82 to 84 per cent., considering all stationary and rotary transformer losses and line losses.

It will be seen, too, that with these special generators we have the advantage of working them and their engines at full load all the time, and, therefore, at maximum efficiency, and we also have the additional important advantage of avoiding duplication in machinery and being enabled to use the same investment in machinery for the maximum load, both in the main station and sub-station, when the maximum loads do not coincide, which is the condition ordinarily met with in America.

In many of these sub-stations it may be found advantageous to operate series arc dynamos for municipal or commercial lighting in territory not covered by the Edison network, and in this case the rotary current transformer becomes an exceedingly useful machine. The shaft of the rotary may be provided with a pulley and belted to a pair of arc dynamos in tandem or to a line shaft to which are belted the arc dynamos to be driven.

The rotary may then be used as a converter of alternating current to direct current, and at the same time as a motor driving the arc dynamos. In this way its capacity may be utilized advantageously and the machine operated at good efficiency.

The rotary current transformer is exceedingly useful in developing new territory, since the machines are very small for their output, and a rotary sub-station will thus require only one-third the space of a steam station of the same capacity, and moreover the investment will be less.

Compared in point of economy of operation with a direct current tie line sub-station, or a storage battery sub-station fed by a direct current tie line, the rotary current transformer sub-station is much more efficient and requires less investment for the same output when the average peak width of the sub-station is over three hours, as is the case in nearly all of our American stations.

We have seen that the efficiency of the various rotary transformer methods ranges from 74 to 85 per cent., and experience in the operation of storage battery sub-stations shows the watt loss through the battery itself to be 25 per cent. In addition to this we must consider the energy required to operate the booster for charging the battery, and also the loss of energy in the tie line between the stations. The labor required to operate the rotary current transformer sub-station is very small, only dynamo tenders being required.

Compared with the ordinary steam station in the residence district, the economy of operation of the rotary transformer stations is very pronounced; two-thirds of the cost of fuel in the steam station and all labor and supplies incident to the operation of the boilers and engines may be saved, and during 16 or 18 hours each day the sub-station may be operated with only one man, and without any additional labor in the main station.

In connection with the rotary current transformers in the sub-station, storage batteries may be employed, if desired, to be used as auxiliaries in cases of emergency, but they will not increase the efficiency of the system.

Appreciating the value of broadening the load curve of their low-tension stations, a few of the companies have taken up contract arc lighting, both for commercial and municipal service, with the result that several of the residence stations which formerly had an average peak width of two to three hours now enjoy a peak from five to seven hours in width. This tendency to widen the peak width lessens the value of the storage battery in residence stations, owing to its great cost, and increases the value of the rotary transformer method for sub-station work.

The real field for the storage battery as an economizer is in its employment in conjunction with the main steam generating station, erected in the station itself when the latter is located in the electrical center of the district, and at the center of distribution when the main generating station is situated at a point distant from the electrical center of the territory to be supplied.

The rotary current transformer methods, besides being more efficient in themselves, when compared with other systems, increase the economy of the main station by loading the units in that station in a manner similar to the storage battery.

The field for economy in the manufacture and distribution of electrical energy has not yet been exhausted, and there remains much that may be accomplished in electrical as well as steam engineering, but the best results cannot always be obtained by adhering to old methods and barring from our doors the experience gained by those who have been thinking along different lines than ourselves.

We must acknowledge the good to be derived from the use of the alternating as well as the direct current, when properly applied, and we should so employ them that we may enjoy the benefit of the advantages of both without the disadvantages of either, and thus devise for ourselves a system of generation and distribution which will be more efficient and more flexible in operation than any method which lies within the reach of the alternating or direct current alone.

Discussion.

The discussion was opened by R. R. Bowker, who said that his recent inquiries in Europe showed results confirming generally the position taken by Mr. Ferguson, but he pointed out that the investment already made in steam sub-stations was by no means rendered useless by the new method, as, so long as the lighting load was characterized by a high peak, the steam stations could be profitably operated to carry the peak portion of the load.

H. F. Parshall discussed English distribution systems for power and light, noting the high periodicity chosen in most of the English alternating distributions, and the large proportion which incandescent lighting formed of the total load in those systems. He did not see an advantage for lighting alone of changing the alternating current to direct current for distribution to consumer.

C. L. Edgar pointed out that the choice of either of the three generating arangements described by Mr. Ferguson for any given case would depend upon the proportion of alternating current and direct current in the total demand of the consumers, so that the different choice of method in Chicago and in Brooklyn had been controlled by local conditions.

W. S. Barstow described very fully the new Brooklyn generating station at Bay Ridge, the three-phase transmission at high pressure of alternating current, and the transformation of the three-phase current by means of rotaries into low-tension direct current for distribution on the Edison three-wire system, and the operations of synchronous motors driving arc dynamos for high-tension direct current series arc lighting. The distance to one sub-station by the route now used is 12 miles, and the service is perfect. A storage battery is placed in one station as a reserve.

S. Dana Greene pointed out in reply to Mr. Parshall that American city conditions differ from those of London and other English cities in that there is an important demand for direct current for many services for which alternating current was not available. He discussed and described some details of rotary sub-stations, particularly the independent regulation of pressure at sub-station according to its own requirements.

J. W. Lieb, Jr., emphasized the necessity for the distribution of direct current by instances from both European and American practice. He incidentally noted the superiority of direct current arcs over alternating arcs; and he described a temporary transmission used by the New York Edison company in which a two-phase motor supplied by high-tension currents drove a pair of low-tension direct current dynamos feeding into the Edison three-wire mains at a place where there was a large demand for current.

President Insull stated that the Chicago Edison company's experience had proven the advantage of concentration of generating plant. He remarked that the instances of sub-station distribution which had been mentioned in the discussion were all lo-

cated in large cities, but that the principle was equally applicable to smaller stations, and that many of these might with advantage be rearranged or extended in this way. He recommended the study of the method to all present, with a view to its possible application in their own cities.

R. R. Bowker summed up the discussion by saying that no distribution would fit the conditions of central station work to-day, unless it possessed the flexibility and the wide range of application which characterized the original three-wire system, and that it seemed to be impossible to secure these in conjunction with long-distance transmission except by the use of rotaries, and Mr. Ferguson, in closing, adopted Mr. Bowker's expressions.

Evans Electric Company's Specialties.

The accompanying cuts illustrate respectively the dynamos and motors and the storage cell now being exploited by the Evans Electric company, 61-63 North Ashland avenue, Chicago.

Relative to the Evans company's dynamos and

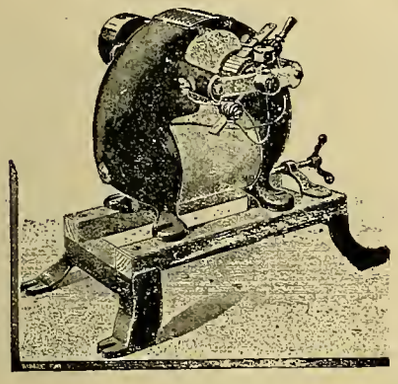


FIG. 1. EVANS DYNAMO.

motors it may be said that they are, generally speaking, of the same design as illustrated in Fig. 1 and range in capacity (in 16 candle power lamps) from 20 to 200. The company, in its circular, guarantees the armatures of these machines against burn-out for five years and offers to repair free of charge, excepting transportation charges, any burned-out armature returned to the factory, provided it was not overloaded much above its rated capacity. Dynamos will be furnished compound wound if desired. In building the machines it is the effort of the company to offer at a low price a machine durable and simple and yet one that may be set up and run by anybody capable of understanding the directions which the company provides with every machine. This type of machine is described as provided with a very large commutator of copper and insulated with mica, extra wide brushes and spring brush holders. The boxes in these machines are made of brass and babbitt and are fitted with the Lunkenheimer grease cups. The armature and field cores are made of wrought-iron. The claim is made of twelve 16 candle power lamps per horse power. The Evans

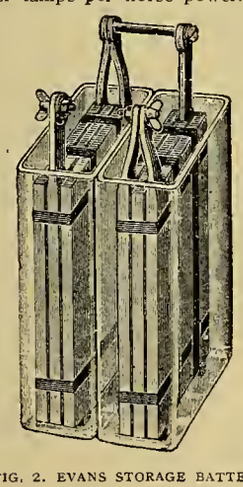


FIG. 2. EVANS STORAGE BATTERY.

Electric company makes a specialty of a 50 light dynamo to be run by a gasoline engine to furnish current for thirty 16 candle power incandescent and two arc lamps. It is figured that such a plant as this can be run at a cost of six cents per hour. The company also makes electro-plating dynamos, complete with sliding base belt-tightener and regulator.

The motors are of the same general design as the dynamos and are built with sliding base belt-tightener and automatic starting box. This box is made of brass and iron and is mounted on slate. The company's one-fourth horse power incandescent motor and arc motor, however, does not require a starting box. The 4, 10, 30, 50 and 75 volt motors are especially adapted for storage battery work. The one-fourth horse power motor is suitable for dental use and has a two-speed pulley, also a reversing attachment. The company's arc motors have copper brushes, while the other styles are fitted with woven wire gauze or carbon brushes, as desired.

The storage battery cell (Fig. 2) exploited by the Evans company is of the "Simpson type," and it is claimed that its plates will not buckle and that they retain their charge for months and are always ready for use and require no attention except a little water added when necessary to replace loss by evaporation. The elements always remain in the solution and do not have to be lifted out when not in use. The Simpson 30 ampere battery weighs eight pounds. The glass jar is seven inches high, two inches wide, 5¼ inches deep. It is stated that these storage batteries have a uniform electromotive force of 2.3 volts, and will discharge a current of not to exceed eight amperes (which is the maximum discharging rate) without variation of electromotive force of over five per cent. between full charge and discharge. Full directions are sent with every battery, also a package of sealing compound for sealing batteries, so they can be carried without spilling solution.

The Evans company also makes a specialty of rewinding armatures and general repairing.

COMMUNICATIONS.

The Thomson Recording Wattmeter.

To the Editor of the Western Electrician:

There appears in a paper by Mr. Ricks, read before the British Association at Toronto, a description of certain tests made in my laboratory on various electric supply meters. From the results there given it would appear that the Elihu Thomson energy meter (or so-called "recording wattmeter"), when used at ordinary temperatures reads about 13 per cent. too low at one-tenth full load, and that, when measuring ordinary direct current loads an increase of temperature of 39° C. raises the speed of the meter by about 11 per cent.

I have no reason to doubt the accuracy of Mr. Ricks' results; indeed, the very careful and painstaking way in which he carried out the investigation described in his paper leads me to think it highly probable that the figures and curves which he publishes do really record the behavior of the meters which he tested. But, during my recent visits to the works of the General Electric company at Schenectady and at Lynn, I have become convinced that the particular meter which was lent Mr. Ricks by the British Thomson-Houston company for testing cannot be regarded as a sample of the instruments which are now being manufactured in large quantities.

From his tests of the Thomson meter Mr. Ricks states, "It may, therefore, be surmised that the coefficient [of change of resistance with temperature] of the pressure coil is very much less than that of the copper disk." To construct an energy meter with this difference in the temperature coefficients is, of course, quite wrong scientifically; and Professor Elihu Thomson tells me that in his instructions he has emphasized the fact that the temperature coefficient of the pressure circuit should be equal to that of the copper pressure disk. As a proof that this condition is really fulfilled in the Thomson meters constructed in the States, various curves have been shown me, from which it appears that, at ordinary loads, a change of 40° C. in the temperature of the meter alters the constant only 3½ per cent. instead of by the 11 per cent. found by Mr. Ricks.

Further, I have watched tests being made on one of these meters at Lynn at temperatures of 65° C. and at 24° C. The meter in question was a 50 volt, 15 ampere meter, and, when tested at 52 volts and 11.75 amperes, that is at about three-quarters of full load, there was only one per cent. difference between the results obtained at these two temperatures, although they differed by 41° C.

Next, as regards the difference between the value of the constant of this type of meter at low and high loads, it would appear from the curves which have been shown me recording the results of various tests, that with some specimens, there is practically no appreciable difference in the value of the constant anywhere between full load and one-twentieth full load, while with other specimens the constant is about two per cent. higher at one-tenth of full load than at full load. These are very different results from those obtained by Mr. Ricks with the meter lent him for testing, for he found that the constant at full load had to be increased by 19 per cent. to make the meter read corectly at twentieth of full load.

Some hurried tests at various loads were made in my presence here of the meter already referred to. The results at low loads were not very satisfactory, as the meter armature turns very slowly, of course, at small loads; and time pressed, as the factory was on the point of being closed for three days. Hence we had to content ourselves with timing one revolution only of the armature instead of waiting to take many, as was done in the very much more accurate tests carried out by Mr. Ricks. But it seemed clear that the variation of the constant between full and one-thirtieth of full load was not as large as was found by Mr. Ricks between full and one-twentieth of full load.

Hence, I conclude, both from the curves of previous tests, as well as from the tests which I saw carried out, that the Elihu Thomson meter tested by Mr. Ricks had not merely a much higher temperature coefficient than meters constructed at Lynn, but possessed a greater frictional resistance, or had "an initial energy coil" which was not powerful enough.

W. E. AYRTON.

Lynn, Mass., September 6, 1897.

Car Heater Litigation.

To the Editor of the Western Electrician:

The recent decision on car heaters against the West End Street Railway company of Boston refers to some heaters furnished two years ago by the old organization of the American Electric Heating corporation, similar to those made by another company, but totally unlike the American company's regular car heater, which was in no way involved in the suit.

The suit will be appealed, as is usual.

The patents under which the American company's heaters are made fully protect them and the users of them and have never been called into question, and the American company reports a record of complete satisfaction.

American Electric Heating Corporation,
JAS. I. AYER, General Manager.

Boston, September 11, 1897.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the Western Electrician.]

The Pepin Telephone company has been formed in Pepin, Wis. This company has completed a line from Pepin to Stockholm and proposes placing instruments at Ella, Plum Creek and other points and eventually to reach Lake City, Minn.

C. H. Zarbock has resigned as superintendent of the Brainerd, Minn., telephone exchange and gone to take a similar position at Kokomo, Ind. He is succeeded by Frank Sheldon of Minneapolis.

An effort is being made at Iowa Falls, Ia., to secure sufficient pledges to warrant the construction of a telephone line to Williams, Ia., where connection could be secured with the Cedar Valley system.

The Interstate Telephone company is getting in shape at Edgemont, S. D., to extend its lines.

It is rumored at Sheldon, N. D., that the Forman Telephone company will remove the telephone exchange at that place to Lisbon. There is also talk of local capitalists buying the Sheldon exchange and the line to Lisbon.

The village of Trempealeau, Wis., is unique among all the cities that have telephone service in the character of its complaint. With the completion of the La Crosse Independent Telephone company's system to that place there are four telephone companies operating in Trempealeau. And the home telephone company has an exclusive franchise, too. The residents think they have a little too much telephone service and altogether too many wires in the streets.

The City Telephone company of Viroqua, Wis., has completed its exchange and starts with 60 patrons.

The new telephone exchange at Chatfield, Minn., is expected to be in operation in October.

It is understood that the Southwestern Telephone company of Pipestone, Minn., will connect with Marshall, Tracy, Ruthton, Holland, Slayton and Woodstock, Minn.

The Minnesota Central Telephone company is sounding sentiment at Eden Valley, Minn., with a view to making telephone connection with that place. The company proposes to connect with all towns between Minneapolis and Elbow Lake on the Soo Line.

Electric Lighting on the South Side Chicago.

The Chicago Edison company has acquired possession of the plant and business of the Chicago Illuminating company on Twenty-first street, Chicago, and will take possession October 1st. The latter corporation's financial difficulties some time ago made it necessary to dispose of the property or reorganize upon an entirely different basis, and a committee has had charge of the affairs of the company, endeavoring to bring about a desirable settlement.

The company's business represented the combined efforts of three small enterprises which have been in operation on the South Side for several years. The first of these was a Thomson-Houston plant at Thirty-first street, the second, using Excelsior apparatus, was in practically the same territory, and the third was located in Twenty-first street. All were established before the Chicago Edison company's South Side station was in operation, but they had made scarcely any material advancement against that corporation, and for some time it has been seen that they must eventually drop out of the contest. It is announced that the investment represented by the Illuminating company amounted to $250,000, but the purchase price in the transaction of last week was about half that sum, it is believed. It is announced authoritatively that the Twenty-first street plant will be closed and the business carried by the present Edison stations. The principal business of the company was in supplying arc lights.

Another interesting event in Chicago lighting business is the announcement that Samuel Insull, president of the Chicago Edison company, has

been elected president of the Hyde Park Thomson-Houston company. The controlling interest in this corporation recently changed hands, but it is not announced whether the Chicago Edison company or the Calumet Gas company secured the property.

It may be accepted as a fact, however, that the policy of the old management will be discarded at once. This will effectually put an end to the proposed consolidation of the South Side companies and make such an arrangement impossible. It may also be taken for granted that the rate-cutting war will cease so far as these companies are concerned.

Disastrous Collision on an Electric Railroad.

A bad accident happened on the Suburban railroad in the town of Cicero, near Chicago, on September 14th, and, as near as can be learned 23 persons were injured, but none dangerously. This is the electric road described in the Western Electrician of July 31st as operated on conditions nearly approximating those that obtain in steam railroad service. It has track of standard gauge, long, heavy cars, and runs for considerable distances over its own private right-of-way. The accident was caused by a head-on collision on a single track during a dense fog in the early morning. The electrical equipment was in nowise at fault, and it is said that if the cars had not been so heavy and strong the accident would have been much worse.

CORRESPONDENCE.

New York Notes.

New York, September 14.—The fight between the Third Avenue Railroad company and the Metropolitan Street Railway company over the proposed trolley conduit in Second avenue goes merrily on. It is now in the Supreme Court. One lawyer for the Third Avenue company contends that by the terms of its charter the Second Avenue company is debarred from using any power but horse power south of Forty-second street. This provision was ratified by the Legislature in 1854, it is said, and this took the question outside the authority of the railroad commissioners, who last August approved the change of motive power, subject to the fulfillment of the legal requirements. Counsel further argued, rather curiously, that the conduit for the electrical wires was in the nature of a vault or cistern, and should therefore be paid for before the construction of the trolley road was begun at a rate of not less than 30 cents a cubic foot to the city. This would make no less a sum than $1,663,200. The lawyers on the other side argued that this case was similar to those of the Sixth and Eighth Avenue railroads, in which Justice Beach ruled that the work of construction for the change of motive power could not be interfered with. Justice Beach's ruling has been affirmed by the Appellate Division.

While the electric launch Corcyra was returning to John Jacob Astor's yacht Nourmahal, after landing its owner at a North River pier on Wednesday last, it was struck and sunk by the fast river steamer Mary Powell. One sailor was in charge of the launch, and he was rescued. The matter is being investigated, and it is possible that Mr. Astor may enter suit for damages.

A curious accident occurred on Eighth avenue one evening last week. Frederick W. Gerken was walking down the street with his brother, Charles A. Gerken. They were passing the dry goods store of Jonap & Co., at No. 289 Eighth avenue, when Charles heard a noise overhead. He saw a heavy arc lamp swinging back and forth, and the light was sputtering. He noticed that something was wrong, and, grabbing his brother Frederick by the arm, he tried to pull him away. He was not quick enough, and the lamp fell with a crash. The globe struck Frederick on the head, crushing his stiff derby hat and cutting a two-inch gash in his scalp. The framework of the lamp struck him on the shoulder, and man and lamp went to the sidewalk in a heap. Charles did not attempt to remove the lamp, but ran into the store and had the current cut off. Then he pulled his brother away from the wreck. A policeman helped take the injured man to the police station, and from there he was sent in the patrol wagon to a hospital. His injuries are not serious, aside from the cut in the head and the shock.

The Rapid Transit Commission and the park commissioners are defending their respective positions in relation to Battery Park. Alexander Orr, the president of the former, has written to the latter, charging them with imperiling the whole rapid transit scheme. In defending the stand taken by the park commissioners in this matter, Samuel McMillan, president of the board, said to a reporter: "This is not a question at all of the preservation of two grass plots and a few trees. The issue is an extremely broad one, and involves the safety of practically the whole of Battery Park. The plans drawn up by the Rapid Transit commissioners are so general in character, and the powers given to them by the Legislature so extensive, that it is within their province to appropriate the choicest portions of the park for their project. To allow Mr. Orr and his fellow commissioners to cut up the ground for the purpose of making a tunnel and to build a station, to and from which 5,000 to 10,000 people an hour will pass, will utterly destroy the character of the park. As I have said, the plans which have been submitted us are so general in construction as to bind the Rapid Transit commissioners to nothing. All that we ask for is that specific and definite details should be placed before us. When that is done we shall be ready to give our consent, and, if necessary, will even call a special meeting to place our approval on record. I am as much in favor of rapid transit as anybody, but it would not be consistent with the oath I have taken to preserve the public parks to agree to the plans in their present form."

M. S.

New England News.

Boston, September 13.—At last the lease of the West End Street Railway company to the Boston Elevated Railroad company, approved by the directors of both corporations, has been given to the public. It has been anxiously awaited. The lease is made to commence on October 1st, and to run 99 years, and the Elevated road is to pay the interest on the outstanding bonded indebtedness of the West End road and eight per cent. upon the capital stock of the West End. The lease covers all the property and franchises of the West End street railway, and includes an assignment of its rights under the subway contract. It provides that the property is to be operated by the Elevated road in accordance with the requirements of all public boards, and provides also that the "L" road shall make such additions and increase the transportation facilities as may be necessary for the safe and convenient transportation of the public. It provides for the issue of stock and bonds by the West End for the payment of permanent betterments and improvements so far as the railroad commissioners may approve. There is a general provision by which all questions which arise between the parties to the lease shall be decided by an arbitration board, to consist of three persons, one to be chosen by each of the two parties, and the third by the two so chosen. The interest on the bonded indebtedness of the West End is to be paid by the Elevated directly to the bondholders, and the income of eight per cent. is to be paid directly to the holders of the stock. Generally speaking, the effect is to put the whole management of the operating of the road in the hands of the Elevated company.

The commission created by the last Legislature to inquire into and report on the relationship of municipalities to electrical street-car development is securing valuable data from many of the larger cities throughout the country. Commissioner Adams is absent in Europe on a similar mission, and upon his return the commission will settle down to active operations on the lines laid down for its conduct. Commissioners Crapo and Hayes have been making preliminary studies of the relations existing between the street-car companies of the larger cities of the West and the municipalities in which they are operated. The growth of the electrical systems and their close identification with the business interests of the localities in which they are situated are matters which the Legislature of 1897 evidently considered should be supervised by the state. An important consideration in the future extension of electric lines would appear to be to what extent should the public highways be further encroached upon.

The management of the Lewiston and Auburn electric railway will immediately begin a survey of the various routes over which extensions are contemplated. Two hundred thousand tons of steel rails has been purchased and will be shipped to the various spots convenient to the extensions. The routes of extension are to the town of Turner to Sabatus and from Lewiston to Bath, through Lisbon, Topsham and Brunswick, with an aggregate of 75 miles, at a probable expense of $750 000. Work will be begun on these extensions within a month.

C. S. G.

PERSONAL.

Frank S. De Ronde, the manager of the Standard Paint company of New York, made a flying visit to Chicago on Tuesday.

C. J. Sturgeon, manager of the electrical department of the Erie City Iron Works of Erie, Pa., was a recent Chicago visitor.

W. R. Pinchard, who has been connected with the electrical trade in Chicago for about eight years, has recently accepted a position as city salesman for the Electric Appliance company.

Funeral services over the remains of Henry B. Stone, late president of the Chicago Telephone company and Central Union Telephone company, who died at his summer home in New Bedford on July 5th last, as the result of an explosion of fireworks, were held in Graceland Cemetery, Chicago, on September 15th.

Charles A. Chapman, lately with Naugle, Holcourt & Co., and designer of the power house and car shed of the Suburban Railroad company, has opened an office at 1020 Monadnock block, Chicago, as a consulting engineer. Mr. Chapman will make a specialty of steam and electric power plants, power transmission and railway construction.

Something like 50 prominent scientists, who came over to attend the recent meeting of the British Association for the Advancement of Science in Toronto, made an extended tour of Canada, many of them being accompanied by their wives. They have gone as far west as the Pacific coast. Lord Kelvin, Lady Kelvin, Sir John Evans, Lady Evans, Lord Lister, Professor Ramsay, Sir George Scott Robinson, Prince Krapotkin, Dr. J. Scott Keltie and Professor Silvanus P. Thompson were in the party.

A monument to the memory of Samuel Thomas Sömmerring was unveiled a few days ago in Frankfort-on-the-Main. Sömmerring was a German physician, and his countrymen claim that he invented the electric telegraph. He did, indeed, produce a telegraph in 1808, but it was a very cumbrous and complicated affair. It required 35 wires for its operation (although later the number was reduced to 27), and the signals were obtained by the decomposition of water in 35 little glass tubes. This, of course, was not a practicable telegraph, but Sömmerring nevertheless did much to advance the study of electricity by his researches and experiments. He was born at Thorn in 1755 and died at Frankfort, the city which has now honored his memory, in 1830.

ELECTRIC LIGHTING.

The city controller of Chicago is advertising for bids for excavating and laying conduit for street arc lighting in Cottage Grove avenue, between Twenty-second and Thirty-third streets, and in Wabash avenue, between Fourteenth and Twenty-second streets. He also advertises for 29 single-carbon arc lamps and posts, and 25,740 feet of lead-covered cable. Sealed proposals will also be received until noon of September 21st for the exchange of one 60-light Western Electric high-tension, direct current arc dynamo, now in use by the city of Chicago, for one new 100 light, high-tension, direct current, arc dynamo to be furnished to the city.

ELECTRIC RAILWAYS.

The Suburban railroad of the West Chicago suburbs is now connected with the Lake Street "L" road, and makes its down-town connection with the latter.

The City Passenger Railway company of Baltimore denies that it contemplates the substitution of electricity for its cable service on Madison avenue and Gay street.

Cairo, in Egypt, has an electric railway system that was installed by a Belgian company, working in conjunction with German electrical engineers. The English are "kicking."

The railroad from Birmingham, Ala., to Pratt City and Ensley City, about seven miles long, is now operated by electricity, which displaced steam dummy locomotives. Much quicker and pleasanter service is secured, and the patrons of this line, which is owned by the Birmingham Railway and Electric company, are greatly pleased.

TELEPHONE.

The directors of the American Bell Telephone company declared the regular quarterly dividend of three per cent. on September 15th. The dividend is payable October 15th to stockholders of record of September 30th. This dividend of three per cent. makes 10½ per cent. declared so far this year.

Omaha has now a long-distance telephone connection and can talk to Chicago and New York. The long-distance "opening" in Omaha took place on September 15th, and the Nebraska Telephone company invited a large number of business men to its building at Eighteenth and Douglas streets to enjoy the novelty.

ELECTRICAL SECURITIES.

It is stated that the increase in the net earnings of the Erie Telephone company this year will exceed any in the company's history, and will, it is said, warrant an increase in the dividend rate should the directors desire to make it.

The Western Union Telegraph company reports for the quarter ended September 30, 1897 (partly estimated): Net revenue, $1,750,000, increase, $162,467; interest and sinking fund, $245,000, increase, $1,641; balance, $1,505,000, increase, $160 86; dividend, $1,216,975, increase, $25,014; surplus, $288,025, increase, $135,812; previous surplus, $7,647,541, decrease, $148,366; total surplus, $7 935,566, decrease, $12,554. The annual report of the company will be submitted to the annual meeting October 13th.

MISCELLANEOUS.

Mayor Harrison and other city officials of Chicago are inspecting eastern garbage reduction plants. It is possible that a plant to utilize the garbage in the production of electricity may be established in Chicago.

The Municipal Board of the city of Belize, British Honduras, has under consideration the construction of an electric light plant for lighting the public buildings and streets of that city. A telegraph line of 200 miles is also to be erected, and there is a rumor that a telephone line will be used in connection with it.

The Rochester (N. Y.) Acetylene Light, Heat and Power company has been incorporated and

capitalized at $100,000. The company will manufacture acetylene gas burners, generators, gasometers and lamps, and mechanisms in connection therewith. The directors are Henry E. Shaffer, Myron W. Sprague and Willey H. Almy, all of Rochester. The stockholders and holdings are: Henry E. Shaffer, 300 shares; Leonard Henkle, 200; Myron W. Sprague, 200; Elmer E. Almy, 50; Willey H. Almy, 50.

This curious note comes from Oswego, N. Y.: Jesse A. Hathaway, a prominent lawyer, died suddenly to-night (September 8th) under unusual circumstances. In company with his wife he attended the weekly prayer-meeting at Grace Presbyterian Church. As he rose to pray a belt at the electric company's power house broke, causing the extinguishing of all the electric lights in the city, those in the church included. Mr. Hathaway fell to the floor, and when the gas was lighted a moment later he was found to be dead. Many persons fled from the church. Coroner Vowinkel and physicians who were summoned said that death was due to apoplexy.

TRADE NEWS.

The Standard Underground Cable company has just established a southeastern sales department, with headquarters in the Betz building (rooms 1225-26), Philadelphia, in charge of T. E. Hughes.

The Farr Telephone and Construction Supply company, Chicago, has just issued an attractive calendar covering a period of a year from August 1, 1897. Exceptional taste is shown in the arrangement of the calendar, which is printed handsomely in three colors. A copy will be sent to anyone applying for it to the Farr company.

Sealed proposals for the purchase of the book accounts, bills receivable, stock shares and other property of the Metropolitan Electric company will be received by the Chicago Title and Trust company, assignee, at 100 Washington street, Chicago, until noon of September 24th. Information can be had at the office of the assignee.

The Automatic Electric Traction company, Lock Box 1118, Chicago, has purchased Foster's patent electric supply system for railways (patented November 27, 1894), with all improvements. It is now prepared to make plans or estimates of cost, or it will lease or license the right to use this system. For information write to the address given.

The anti-trust Warren Electric and Specialty company of Warren, O., keeps hammering away at the incandescent lamp pool. Its advertising literature is very effective, and its latest production, "Flim-flam Tests versus the Test of Experience" is no exception to the rule. The booklet makes interesting reading for all electrical men.

The Proctor-Raymond Manufacturing company of Buffalo has recently been reorganized, and its working capital has been largely increased. Mr. John Gowans, a prominent and wealthy business man of Buffalo, will have charge of the finances as secretary and treasurer. The company is getting ready to put on the market several patented specialties in bells, annunciators and similar lines.

The Armorite Interior Conduit company of Pittsburg, Pa., has just established an office in New York city in room 711 Havemeyer building, and Jas. F. Cummings, the enterprising president of the company, says that his company proposes to make a vigorous push for its share of the business in New York. With the able assistance of R. B. Corey, the general manager of the New York office, it would seem that "Armorite" should be extensively used in and around New York city from now on.

A new product called mica fiber is manufactured by the Diamond State Fiber company of Elsmere, Delaware, for which the company makes some interesting claims. This fiber is said to combine the high insulating properties of mica, together with the toughness and flexibility of hard fiber, being easier to turn, saw or drill than hard fiber. In many respects it would seem as an article destined to have an assured position in the electrical trade. It is made in sheets, rods, tubes, etc., and the company reports that it already has a large call for this product.

The Hartley Electrical Works, Chicago, recently completed a special job of rewinding two 250 light, 70 volt United States dynamos, which were used in the electric light plant of the Palmer House, Chicago. While rewinding of machines is, of course, very common, the case in question has several exceptional features which, no doubt, will be of interest to the readers of the Western Electrician. The dynamos mentioned above were rewound for 110 volts and compounded, and the owners are now able to obtain 110 volts without an increase of speed, while the compound winding gives perfect regulation. Moreover, 300 lights are now obtained from each machine, whereas with 70 volts but 250 lights were possible. The Palmer House people write in the highest terms of this work to B. Hartley of the Hartley Electrical Works, who superintended the job. They are, of course, highly pleased with the superior service the machines now give. This is but a single instance of the many fine pieces of work turned out by the Hartley company.

BUSINESS.

The Western Electric company is placing upon the market a special annunciator, called style D, and is also manufacturing a superior line of speaking tubes. It reports that the demand for its Economy batteries is increasing.

The elaborate catalogue of W. H. Weston & Co. of Philadelphia is descriptive of switches, switchboards, etc. It is profusely illustrated with halftones showing the apparatus; and the tables which are to be found in this catalogue show the result of great care and attention to the details of construction work in this line of business.

The Central Manufacturing company, Chattanooga, Tenn., manufacturer and dealer in yellow pine cross-arms, oak and locust insulator pins and brackets, reports an increased trade. The business of this firm has been steadily picking up, and at the present time it has plenty of orders on hand. Its products seem to give entire satisfaction wherever used.

The Scott & Janney Electrical and Manufacturing company of 1707-1709 Filbert street, Philadelphia, is making extra preparations to meet a large demand for its alternating current motors for single, two and three-phase systems, which are at present attracting so much attention from the electrical trade because of their new method of construction, which appeals very pointedly to the purchaser who is looking for first-class electrical apparatus at a minimum price.

The advertising agency of Jules Viennot of Philadelphia is at present enjoying a prosperous condition of business, showing a large increase over that of last year. The mechanical lines which are served by Mr. Viennot take in some of the strongest manufacturers in the country. It is a pleasing fact to note that September 1st marked the completion of the eighteenth year since the establishment of this business, which has always maintained its high standard.

The J. C. McNaughton company, Bourse building, Philadelphia, which is one of the largest purchasers of railroad ties and poles in the country, reports that its business for the last two weeks has shown such a large increase that is has been obliged to arrange for extra facilities in order to fill orders promptly. One of the large orders which this concern has recently received was from the Greene County Traction company of Coxsackie, N. Y., consisting of street railroad ties for the main line and its branches.

The Murray Iron Works company of Burlington, Iowa, is selling a large number of Sioux Corliss engines and high-pressure tubular boilers, and evidently feels the revival of prosperity. In a long list of recent orders it is noticed that the company is building a 600 horse power cross-compound, direct-connected, condensing Sioux Corliss engine for the San Antonio (Tex.) Street Railway company. It is also doing a large business in mining engines and boilers for Mexico and the West.

An article of considerable merit which is finding favor in electric light and street railway plants is Holm's "Tesoline," a commutator compound for which the Boiler Expurgator company, 115 Dearborn street, Chicago, is the sole selling agent. This compound has been in use for over a year, and since the above company has begun to push it actively its sales have greatly increased. It has been used by many of the prominent electric light companies throughout the West, particularly in Chicago plants, and these users, without exception, have informed the manufacturers that the compound is giving entire satisfaction. Special claims made for "Tesoline" commutator compound are: It prevents sparking and cutting; will not gum the brushes; is guaranteed to keep the commutator in good condition. It also, it is said, affords a great saving in brushes. A free sample will be mailed to anyone desiring to give "Tesoline" a trial.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued September 7, 1897.

589,412. Auxiliary Electric Contact. William M. Brown, Johnstown, Pa. Application filed February 23, 1897.

In this invention an auxiliary contact shoe is provided for vehicles using the third-rail system, together with means for bringing it into use only as needed.

589,429. Multiple-series System of Electrical Distribution. Charles D. Haskins, Brooklyn, N. Y. Application filed June 8, 1896.

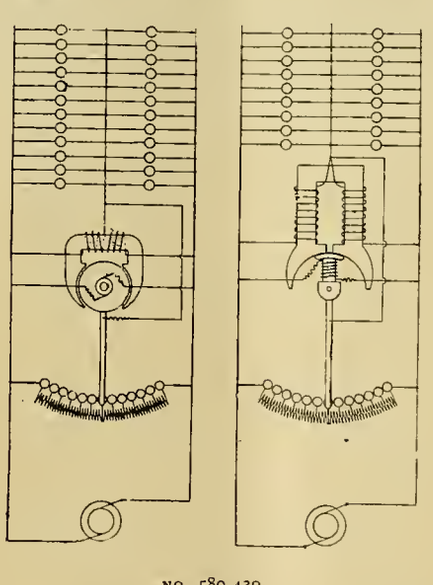
In a system of electrical distribution, the combination with a source of electrical energy of the mains of a working circuit connected therewith, wherein the translating devices are connected in multiple series between the mains; a compensating conductor and an electro-magnetic device consisting of a polarized element and an element energized by differential coils respectively connected between the compensating conductor and the mains, and means controlled by the actuation of the electro-magnetic device for maintaining the balance of the system.

589,430. System of Electrical Distribution. Charles D. Haskins, Brooklyn, N. Y. Application filed July 6, 1896.

In a multiple series system of electrical distribution, the combination with main and equalizing conductors of a generator from which the main conductors are led, an electro-magnetic switching device having two relatively movable elements, an armature and a magnet, one of these elements being connected with the conductors and adapted to have its polarity changed as the load predominates in one branch of the system or another, the other of the elements being polarized in a constant direction, and a dynamo-electric machine adapted to be included in circuit with one branch or another of the system by this switching device.

589,431. Telephonic Measured-service System. Hammond V. Hayes, Cambridge, and Thomas C. Wales, Jr., Newton, Mass. Application filed June 23, 1897.

At a telephone sub-station is placed a call-register responsive for the registration of a call; two successive oppositely directed electrical current impulses traversing the main circuit in a definite order; the call apparatus at the sub-station is organized to establish in the circuit the required initial current impulse of appropriate direction when operated to transmit the call, and switch apparatus at the central station is adapted when operated for the answer of the call to establish in the circuit the required final current impulse of direction opposite to that of the first.



NO. 589,430.

589,433. Starting-box for Electric Motors. Robert B. Hirst, Brooklyn, N. Y. Application filed July 3, 1897.

The combination with a resistance box and its lever of a switch controlling the main circuit movable to closed position by the lever, a spring tending to open the switch, a retaining magnet adapted when excited to hold the switch closed, and means operated by the lever for breaking the circuit of the magnet to release the switch.

589,445. Electric Hair Singer. David Seide, Hartford, Conn. Application filed April 15, 1897.

This tool for singeing hair consists of a comb and an insulated handle. The comb is made of conducting material, and is connected with an electrical circuit. A wire of comparatively small conducting capacity is held adjacent to the comb-teeth and adapted to be connected with an electrical circuit. The comb and fine wire are electrically connected at one end; there is a switch in the handle for opening and closing a circuit through them.

NO. 589,445.

589,452. Traveling Contact for Electric Railways. William F. Weiss, Stockton, N. J. Application filed April 24, 1897.

An overhead trolley device having a transverse rod on which the revolving contact wheel can move laterally, with springs to bring it back to the normal central position.

589,485. Electric Rail Bond. George H. Scott, Worcester, Mass. Application filed January 26, 1897.

The holes in the rails are provided with bushings cut away on one side to allow the conducting wire to be bent closely against the side of the rail.

589,509. Electrical Igniter for Gas Engines. Edward R. Moffitt, San Francisco, Cal. Application filed February 27, 1896.

A new form of spark generator for producing the explosions in a gas engine.

589,510. Watchman's Electric Time Recorder. Charles H. Phinney, Boston, Mass. Application filed December 9, 1895.

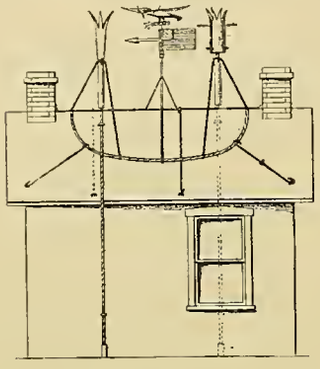
The indicating apparatus is operated by means of a number of circuit controlling devices.

589,523. Process of and Apparatus for Electrolyzing Fused Salts. Johann Boelsterli, Neuhausen, Switzerland. Application filed October 27, 1896.

The process consists in electrolyzing a fused alkali metal salt and liberating the alkali metal exclusively at the surface of the electrolyte. Suitable apparatus is provided.

589,543. Electric Motor Car. Harold P. Brown, New York, N. Y. Application filed March 11, 1893.

One claim reads: In an electric motor car, the combination of the car axle with an electric motor, a planet gear disk or wheel carrying planet gears, an internal gear meshing therewith, a sleeve loose on the car axle and furnished with a pinion meshing with said planet gears, means for communicating motion from the motor shaft to said sleeve, a friction brake wheel and friction brake, and a supplemental brake wheel, and a revolving supplemental brake engaging said supplemental brake wheel.



NO. 589,566.

589,556. Transmission of Energy by Alternating Currents. Charles S. Bradley, Avon, N. Y. Application filed March 21, 1896.

A system of transmission for alternating currents, comprising an alternating current generator of definite fundamental rate and a circuit containing inductances connected in parallel at intervals, these inductances being proportioned to produce resonance of the circuit with the generator.

589,557. Lightning Arrester. Charles S. Bradley, Avon, N. Y. Application filed May 28, 1895. Renewed February 9, 1897.

A lightning arrester comprising two conductors in mutual inductive relation, having two terminals connected to line and two to a translating device, the conductors being associated to oppose one another in magnetizing effect under the working current passing to the translating device, thereby permitting such current to pass freely, but assisting one another in magnetizing effect when the line is charged by a lightning stroke.

589,566. Lightning Rod. Elbridge Marshall, Garnett, Kan. Application filed June 1, 1897.

Mr. Marshall proposes for a lightning rod a crown or endless cable provided with arms radiating in various directions upon the roof of the building, a pair of rods or cables connecting with the same and grounded at their lower ends, and provided at their upper ends with hollow or cylindrical points provided with sub-points or spines, metallic cylinders or sleeves incasing the rods or cables below the tubular points to strengthen them and increase their conductive capacity, and braced vertically by means of guys, which are connected at their lower ends to the crown or cable.

589,582. Electric Switch. Joseph B. Smith, Arthur W. Ferrin and Albert L. Clough, Manchester, N. H. Application filed August 15, 1896.

In an electric switch, electric magnets in series with the field current and armature current of an electric motor, independent armatures under the influence of the magnets, spring-actuated switch blades, a spring attached to one of the armatures for holding it normally away from the pole of the magnet traversed by the armature current, and means whereby a variation of current in the armature or field circuit causes the switch to automatically open.

589,618. Electric Switch and Cut-out for Telephone Boxes. Arthur C. Robbins, San Francisco, Cal. Application filed March 26, 1897.

In an inclosed telephone, a transmitter, receiver and local battery with induction coil and connecting wires, a door attached and opening to expose the interior of the inclosing box, contacts and a lever fulcrumed between its ends, having one portion bent into the path of the door so as to be actuated thereby, and the opposite portion having the contacts on its opposite sides, whereby when one contact is made the telephone apparatus is thrown into the circuit, and when this is broken and the other made the current is shunted around the apparatus.

589,619. Telephone Transmitter for Signal Boxes. Arthur C. Robbins, San Francisco, Cal. Application filed March 26, 1897.

The combination with a box having an outwardly opening door and a transmitter hinged or pivoted therein, of a lug or cleat adapted to contact with and raise the outer end of the transmitter by the closing of the door.

589,624. Underrunning Trolley for Electric Railways. Sidney H. Short, Cleveland, Ohio. Application filed July 29, 1896.

An underrunning trolley comprising a base plate having a central hub, a casting arranged to be seated in the hub, a trolley pole carried by the casting and pivotally mounted to swing vertically, a movable lock for normally locking said hub and casting against relative rotation, the lock arranged in the path of vertical swing of the trolley pole, whereby when the pole is depressed the lock is encountered thereby and disengaged from locking position, thereby permitting the casting to rotate in its seat in the hub; there is also an elongated contact roller carried by the trolley pole.

589,669. Electric Safety Appliance for Railroads. Edward L. Orcutt, Somerville, Mass. Application filed February 6, 1897.

A claim is given: In an electric safety appliance for railroads, a track mechanism consisting of an open track circuit composed in part of both rails of the track, and an open line circuit governed or controlled by the track circuit, and a train mechanism consisting of a supply of electricity, an open circuit charging the track circuit, a closed circuit looping in the line circuit, a magnet in the closed circuit, and a signal governed or controlled by the armature of said magnet.

589,672. Electric Meter. Charles C. Schumacher, and Albert G. Zamel, Chicago, Ill. Application filed May 22, 1897.

In this meter there are a recorder provided with a balance wheel, a pinion on the balance wheel, a toothed segment engaging the pinion, an armature connected with the segment and a magnet for attracting the armature.

589,674. Alternating Current Generator. Frank H. Sleeper, St. Johnsbury, Vt. Application filed May 21, 1896.

The first claim gives this description: In an alternating current generator, a continuously magnetized field, each pole divided to present two or more divisions to the armature, and shaped to the path of its teeth, a revolving armature having teeth of nearly the same form and angular breadth (measured from the axis of rotation) as the said divisions of the field poles and moving close to them, these teeth separated by depressions of substantially the same angular breadth as the teeth, and in combination with these elements circuit-generating coils upon these divisions of the field poles, the arrangement and spacing of the whole being such that for the generating coils of each circuit all the right-hand wound north pole divisions and all the left-hand wound south pole divisions shall, in one position of the armature, have its teeth presented to them, and in the next position when the armature has moved the breadth of one tooth all the left-hand wound north pole divisions and all the right-hand wound south pole divisions shall have its teeth presented to them, whereby when the armature is rotated the magnetic flux is directed alternately through the two opposite wound sets of pole divisions, and an alternating electric current is induced in the generating coils.

589,693. Trolley. Frank W. Canales, Portland, Me. Application filed May 21, 1895.

The combination with a supporting frame having an annular top plate, of a cap fitting over and turning upon the top plate, a trolley wheel mounted on the cap, and double-acting springs between the cap and top plate, these springs having one end connected to the cap and their other ends engaging stops on the top plate.

589,702. Trolley Wheel for Electric Cars. James A. Crawford and Thomas E. Crow, Dallas, Tex. Application filed September 12, 1896.

This trolley for electric cars comprises a frame, a wheel, a wheel axle, disks eccentrically journaled upon the axle, lugs upon the disks, and projections upon the frame lying in the path of the lugs.

589,726. Coin-operated Telephone. Frederick Hoffman, Paragould, Ark. Application filed May 3, 1897.

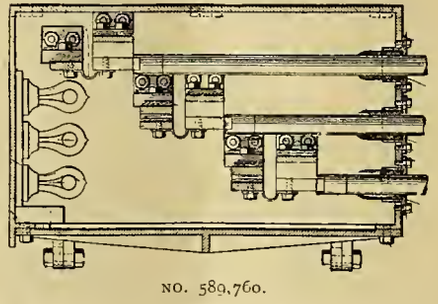
Mechanical means are described, whereby the insertion of a coin in a chute in a telephone serves to close the circuit.

589,742. Static Machine. Cornelius H. Myers and Henry C. Rose, South Bend, Ind. Application filed December 5, 1896.

The combination with a machine for generating static electricity and an inclosing case therefor, of means for refrigerating or reducing the temperature of the air in the case. This apparatus appears to be intended for use in electro-therapeutics.

589,745. Device for Indicating Escape of Gas. Michael O'Donovan, Boston, Mass. Application filed May 24, 1895. Renewed January 25, 1897.

An electrical device for operating an indicator to indicate the escape of gas comprises in its construction a thermostat adapted to be influenced by the gas flame, a resistance coil in circuit with the thermostat, a supplemental thermostat adapted to be influenced by the resistance coil, and an indicator in circuit with the supplemental thermostat, all co-operating.



NO. 589,760.

589,746. Electric Signaling Apparatus and Circuit. Edward H. Owen, Charles N. Williams and Fred H. Donaldson, Garvanza, Cal. Application filed April 22, 1897.

An elaborate electrical signaling mechanism is described.

589,747. Annunciator System. Edward H. Owen, Charles N. Williams, and Fred H. Donaldson, Garvanza, Cal. Application filed June 18, 1897.

The combination of a plurality of pushes and push-button contacts associated with marks or words which identify each one of a series of distant points.

589,760. Electrical Junction Box. George Tailleur, Chicago, Ill. Application filed June 7, 1897.

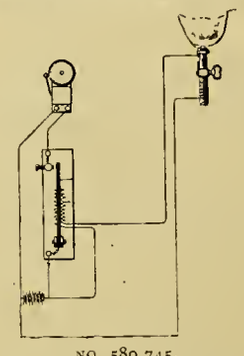
An electrical junction box having holes in one of its walls through which the conductors pass, in combination with perforated flanged bushings, the bodies of the bushings projecting through the holes, and the flanges of the bushings being secured to the box-wall, and suitable packing interposed between the bodies of the bushings and the conductors passing therethrough.

589,783. Dash Electric Headlight. John Kirby, Jr., Dayton, Ohio. Application filed February 10, 1897.

The combination with the dashboard of a railway car, having an opening cut through the dashboard below the top thereof, of an open headlight frame registering with said opening and secured to the dashboard, and a headlight case containing a reflector, a lamp socket, a lamp socket holder and an incandescent electric lamp held in the lamp socket, the headlight case being carried by the frame and detachably held therein.

589,785. Surface Contact Electric Railway. Lee H. Parker, Schenectady, N. Y. Application filed November 18, 1896.

This system is described as combining stationary contacts, switch mechanism for including the contacts in circuit with the source of supply, coils permanently connected between each contact and the ground, a contact shoe mounted on the vehicle and supplying current to the coil as it advances, a magnet mounted at the front of the vehicle co-operating with the coils to close the switches, and a second magnet mounted on the rear of the vehicle co-operating with the coils to open the switches.



NO. 589,745.

589,786. Closed Conduit Electric Railway System. William B. Potter, Schenectady, N. Y. Application filed October 6, 1896.

In this invention the principal features are a feeder, sectional conductors, a track and electro magnetic switches for establishing temporary connection between the feeder and the successive sectional conductors, each switch provided with a single coil in circuit on the negative side of the system, and contacts making direct connection between the feeder and the sectional conductors, each switch furnishing current to more than one sectional conductor.

589,787. Closed Conduit Electric Railway. William B. Potter, Schenectady, N. Y. Application filed November 18, 1896.

This patent is for a system comprising a feeder, track rails and sectional conductors in the roadway, with electro-magnetic switches serving to make temporary connection in sequence between the feeder and the sectional conductors, the switches connected between the negative side of the system and ground by coils in multiple upon the different switches.

589,788. Closed Conduit Electric Railway System. William B. Potter, Schenectady, N. Y. Application filed November 28, 1896.

Here there is a single row of sectional contacts, some of which are directly connected to the feeder by the closing of suitable electro-magnetic switches, while others are connected to ground through high-resistance magnets actuating the switches, the high-resistance coils of these magnets forming a shunt to the motor circuit, and permanent electrical connections connecting each of the motor contacts with more than one of the switches, and each of the switches likewise with a plurality of motor contacts.

589,789. Closed Conduit Electric Railway. William B. Potter, Schenectady, N. Y. Application filed November 28, 1896.

Sectional normally insulated contacts are used, and there are a feeder, switches for connecting the sectional contacts in sequence with the feeder, and electro-magnets operating the switches having a pick-up coil in shunt to the motor circuit, each switch energizing a plurality of surface contacts carrying motor current, and each motor contact taking current from more than one of the switches.

589,790. Closed Conduit Electric Railway. William B. Potter, Schenectady, N. Y. Application filed January 2, 1897.

A series of high-potential studs is arranged alternately in a number of different parallel rows; switches for connecting the studs with the line circuit are provided, and electro-magnets for closing automatically the switch contacts.

589,791. Surface Contact Railway System. William B. Potter, Schenectady, N. Y. Application filed January 25, 1897.

In this system there is a storage battery auxiliary which preserves the connection of the lighting circuit of the car to the surface contacts when the motor circuit is interrupted.

589,792. Closed Conduit Electric Railway. William B. Potter, Schenectady, N. Y. Application filed November 18, 1896. Renewed June 30, 1897.

A feature is a safety device comprising an independent "ground" adjacent to the sectional conductors, having included in its circuit a coil upon the pick up switch.

589,798. Multiple Cut-out for Telephone Systems. Almon B. Strowger and Alexander E. Keith, Chicago, Ill. Application filed Feb. 19, 1896.

The combination with a central station, of a series of sub-stations, an electrical circuit common to all of the stations, a switch, a locking device and two magnets for each sub station, one of the magnets being connected with one of the wires, and the other magnet being connected with the other wire, and means for moving the switch in one direction by one of the magnets and causing it to automatically engage with the locking device, and means for releasing the switch by the other magnet, and means for completing the circuit through either of the sub-stations.

Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, SEPTEMBER 25, 1897. No. 13

Electric Wagon Haulage in Foundation Building.

From the windows of the office of the Western Electrician the work now in progress on the foundations for the new government building forms an interesting spectacle. The site occupies the whole square bounded by Jackson, Clark, Adams and Dearborn streets, and upon it the government is about to erect, at a cost of several millions of dollars, a fine, large edifice to replace the old building on the same location, which was condemned on account of its insecure foundations. Great care is taken to insure permanent and stable foundations for the new building. As is generally known, Chicago has not the advantage of a rock foundation for its buildings, and at the site under consideration the soil has such particularly unsatisfactory characteristics that quite unusual precautions were taken to provide a firm and unvarying support for the great weight of the building which is to be erected.

A general view of the site, showing the work under way, is given in Fig. 2, on the next page. From careful borings which were taken to determine the character of the subsoil, it is determined that hardpan is reached only at the average depth of 72 feet below the sidewalk grade of the adjacent streets. To secure the support of this substratum of hard earth, piling is employed, and before the work is completed between 5,000 and 6,000 piles of unusual length will have been driven in the earth. Steam hammers are now at work driving piles in the central portion of the site, as shown in the picture (Fig. 2). The design of the building is such that the heaviest weight comes on the square central portion, and here the piles are most numerous. The excavation at this place extends 27 feet below street grade, so that piles 50 feet in length are long enough to reach hardpan. These piles are fine, straight logs of Norway pine, and they are driven by 2,000 pound steam hammers. They are to be capped with white oak timbers, 14 by 14 inches, bolted to the piles by wrought-iron drift-bolts 20 inches long. By the aid of ten low-tension arc lamps the contractor for the foundations, the McArthur Brothers company, is pushing the work night and day, and the foundation work will probably be finished by March 1, 1898. The erection of the building will probably take two years longer. Gen. William Sooy Smith is the foundation engineer.

One indispensable feature of the work is the excavation of some 70,000 yards of earth. Much of this has been already done, and, as has been stated, the central pit has been dug down to a depth of 27 feet. The earth taken out is of a heavy, clayey nature, peculiarly tenacious and viscid, and the laborers throw the clods into the wagons with pitchforks instead of shovels. Two temporary roadways have been constructed from the central depression to the street for the use of the teams taking the dirt away. These are constructed of three-inch planking and have such a steep grade that it would be impossible for any practicable number of horses to pull up the loaded wagons. Mechanical means is used instead —in one case a steam hoisting engine and in the other an eletric motor. The use of electrical power for this purpose is something of a novelty, and it was introduced by McArthur Brothers rather as an experiment, but the result has been entirely satisfactory.

The general method of using the electric power is shown in Fig. 1. A 20 horse power series wound Edison motor is installed in a shed (Fig. 3) on Dearborn street, near the corner of Adams, on the street level. It is operated at 220 volts and is supplied with current, through a Cutler-Hammer starting box, from the Chicago Edison company's three-wire mains in the street. The motor is directly geared to a 14 inch hoisting drum, which is equipped with a band brake. The connection with the loaded wagons is supplied by about 125 feet of three-quarter-inch wire rope. This is wound about the drum and is taken from suitable sheaves, firmly secured, down the roadway to the pit where the wagons are loaded. There is a hook at the end of the rope and this is secured to the tongue of the wagon or to the forward axle, as is most convenient. A signal is given to the motorman, and the load is easily pulled up to the street, the horses merely walking up in their places with a look of gratification and without pulling a pound. Fig. 1 is a reproduction of a snapshot photograph taken when the motor was pulling a load up the incline. Two men walk up with the wagon, one with a wedge to block the wheels in case anything should break, and they often take the rope back with them for the next load, although sometimes this is done by an empty wagon going down.

It is no light load that the motor deals with. The driver and wagon weigh about 1,500 pounds and the earth about 5,000 pounds—a total of 6,500 pounds. This is pulled up a grade having a rise of 27 feet in 100, and an average effort of 15 horse power is required. As high as 25 horse power has been exerted in cases where wagons have run off the track. The motor weighs 2,100 pounds and is operated at 1,000 revolutions per minute at full load. It is found to be more economical than the steam hoisting engine and more easily controlled and regulated; it takes up but little space and makes no noise or smoke in the street. The advantages of cleanliness and quiet running are of considerable value in the present location, as the work is done opposite the Great Northern Hotel, and the guests have complained that the steam hoisting engine is a nuisance.

FIG. 1. ELECTRIC WAGON HAULAGE IN FOUNDATION BUILDING.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the Western Electrician.]

Some time ago the county board at Sioux City, Ia., ordered the Iowa Telephone company to remove all its instruments but one from the courthouse. The company did not do so, and as some of the connections promised by the Home Telephone company have not been made, the board rescinded the order.

The Electric Telephone Exchange company of Hudson, Wis., has begun operating its exchange.

The council at Carver, Minn., has granted a franchise to the Western Minnesota Telephone company.

The Werner-Dwelle Telephone company of Lake City, Minn., will construct a line to Mazeppa and Cannon Falls.

The Forman Telephone company is arranging to connect with Wahpeton, N. D., and will have an exchange in operation there soon.

The Michigan Telephone company will reduce its rates on residence telephones in Menominee, Mich., to $24 per year on October 1st.

Edwin A. Knapp of St. Louis has been granted a franchise for a telephone exchange at Ottumwa, Ia. It will connect with the J. C. Hubinger exchange of Keokuk, Ia.

The Dakota Central Telephone company has completed connection between Aberdeen and Huron, S. D., and Big Stone City.

The Wisconsin Telephone company at Madison, Wis., will move its exchange to new quarters soon.

The Mississippi Valley Telephone company of Keokuk, Ia., is an applicant for a franchise at Omaha, Neb.

Diversified Uses of Electrical Power at Niagara.

One of the most interesting of the many lectures and essays that have had for their subject the electrical utilization of the power of Niagara Falls is that written by Charles F. Scott of the Westinghouse company and recently read before the Engineers' Club of Philadelphia. Mr. Scott is clear, forcible and pleasing in his treatment of a theme so well worn that a good style of writing is now necessary to make it attractive. One striking introductory statement is this:

"Most of us have very little conception of large powers. The statement that the power of Niagara is six or seven million horse power conveys no definite idea. A simple illustration may help us to form a conception of its vastness. Suppose pumps be placed below the falls for pumping the water up again to its former level. If a man exerts a force of about 20 pounds per stroke and works at a fair rate for eight hours per day, it would take about 10 times the total population of the United States to pump the water back as fast as it is flowing over the falls. Consider for a moment what this means. If 70,000,000 of us were engaged in manual labor, all the work we would do could be accomplished 10 times over by the power which is now going to waste. All the work of laborers, all our actual exertions in digging, hammering, lifting, climbing stairs, running sewing-machines or riding bicycles probably do not represent the one-hundreth part of this stupendous power."

Further on, Mr. Scott makes approximate mechanical analogues for direct and alternating currents that are interesting: "Ordinary commercial currents are of two kinds, direct and alternating. The direct current is one which flows constantly in one direction. It has a mechanical analogue in the continuous flow of water through a pipe or in the transmission of power by a belt. An alternating current corresponds to a reciprocating motion. If a pipe have a piston in one end which is drawn back and forth so that the water within the pipe has a reciprocating flow, the action is somewhat analogous to that of the alternating current. Corresponding to the comparison between direct current and a belt, we may liken alternating current to motion by a crank. As there are varieties of cranks there are varieties of alternating currents. A shaft may be driven by a single crank or by two or three cranks intermittently. In the same way an alternating current system may employ more than one current, the several currents acting successively. As the uniformity of motion in a shaft driven by an engine of several cranks is greater than when a single crank is used, so the flow of energy or supply of power, which must be intermittent when a single current is used, may be made uniform and constant from two or more suitably adjusted currents. The winding on the Niagara generators is such as to produce two alternating currents, each of which has its maximum value when the other has its zero value. * * * * A two-phase system is best suited for the local distribution, as it possesses certain advantages in regulation of pressure and adaptation to the service to be supplied. On the other hand, three-phase current, or a system in which there are three currents following one another at equal intervals of time, has advantages for long-distance transmission, as the number of wires and the weight of copper required are reduced. The transformation from a low-tension two-phase system to a high-tension three-phase system may be illustrated by mechanical analogue. Suppose a shaft driven by a two-cylinder engine in which the cranks are set at right angles and have but a short stroke and require therefore strong and heavy connecting rods. On this same shaft let there be three equally displaced cranks which are long and consequently give a high velocity to the rods to which they are connected. The rods which are moving at the higher velocity may be comparatively small and light and may therefore be carried to a considerable distance without exceeding moderate dimensions. By a similar arrangement at the other end of the rods the motion may again be reduced by letting the three rods be connected to three cranks on a shaft which is provided with two short cranks driving rods at slow speed. In the electric system heavy wires or copper bars conduct the two-phase current from the generator to raising transformers, which supply a high pressure to an outgoing circuit and which are connected in pairs in such a way as to deliver a three-phase current to the three outgoing wires of the transmission circuit. A reversed arrangement may be used for re-transforming to two-phase currents at low pressure."

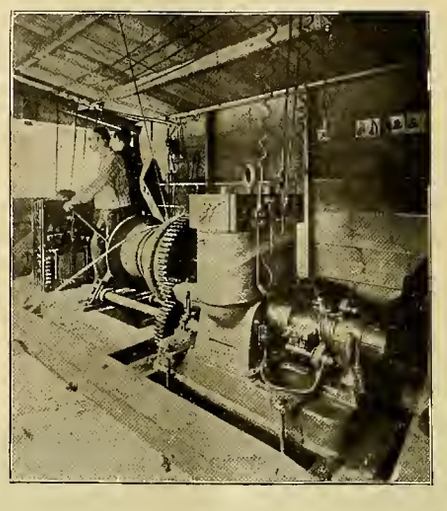


FIG. 3. ELECTRIC WAGON HAULAGE IN FOUNDATION BUILDING.

The concluding portion of the paper is devoted to the commercial applications of the power electrically transmitted by the Niagara Falls Power company. The diagram of circuits herewith reproduced is a graphical aid to the understanding of this diversified industry. Says Mr. Scott:

The first commercial use of the electric power was by the Pittsburg Reduction company in its extensive works on the river a short distance above the power house, for the manufacture of aluminum. The current is reduced in pressure from 2,200 volts to a low voltage and is supplied to machines for transforming the alternating current into direct current. These machines perform the double function of operating as alternating current motors and as direct current generators. The machines are similar in general to direct current dynamos, with the addition, however, of collector rings for receiving the alternating current and introducing it at suitable points in the armature winding. A mechanical analogue is found in the shaft of an engine which receives power by two cranks from reciprocating rods and delivers it to a belt running in a constant direction. This plant has a capacity of nearly 4,000 horse power, which is used in the form of direct current at about 160 volts for the manufacture of aluminum by the Hall process.

In the works of the Carborundum company a large transformer and a regulator are installed which deliver 1,000 horse power of alternating current to electric furnaces for making carborundum, the new abrasive, whose hardness is exceeded only by that of the diamond. The suitable materials, salt, glass-sand, sawdust and coke, for making the carborundum are placed in a furnace built of loose bricks and the current is passed through from one end to the other. The passage of the current produces heat throughout the interior and raises the temperature to a very high degree. The resistance changes during the process, requiring an adjustment of the current in order to maintain a constant supply of energy. This necessitates a change in pressure from about 250 to 100 volts. After about 24 hours a compound of silicon and carbon is formed, the amorphous central core being surrounded by beautiful crystals.

The Acetylene Light, Heat and Power company manufactures calcium carbide by the union of lime and coke in the presence of an intense heat generated by the electric arc. The current passes between two enormous terminals or electrodes which are separated by several inches, and the arc through this space radiates an intense heat. The powdered materials surround this arc. The arc gives an intense light and a loud humming sound having a frequency corresponding to that of the alternations of current. This company has operated with a 1,000 horse power transformer which reduces the pressure to 100 volts. It is now installing several more transformers of the same size.

The Niagara Electro-chemical company uses about 500 horse power in direct current for the manufacture of metallic sodium by the Castner process. The current is delivered at a voltage which may be varied from 125 to 165 volts by means of a regulator connected with the lowering transformers. The number of turns in one of the winding of these transformers may be varied at will, thus changing the ratio between the number of turns in the two windings and thereby raising of lowering the resultant pressure, which in turn varies the pressure delivered by the machine which supplies direct current. One of these machines is the first of its type. It differs from other machines in having no field coils and is termed an "induction rotary." The magnetizing effect, which is usually secured by direct current through the field winding, is here obtained from the alternating current through the armature winding. It possesses many elements of excellence in simplicity of construction and operation.

The Matheison Alkali company is now installing a plant in which about 1,500 horse power will be used in the form of direct current at a voltage variable from about 175 to 225 volts.

The electric light plant for the village of Niagara Falls has in addition to its former steam plant two 400 horse power induction motors which receive power from the Niagara generators and are used for driving the dynamos which supply the commercial lighting circuits. Much of this lighting might be supplied directly by the circuits from the large generators, but a part, notably the arc lighting, cannot be thus supplied, and the motors were introduced as a simple mechanical arrangement for furnishing power to the existing plant. The induction motor possesses many advantages over its rival, the direct-current motor, not only as regards electrical performance, but especially in its mechanical characteristics. As is well known, the commutator in direct-current machinery is the element which is most difficult to construct and which is the part most liable to accident and deterioration and wear, and which calls for care and skill in attendance. This feature is entirely absent from the induction motor, which in its most approved type has no open nor moving electric contacts whatever. The revolving element is ideally simple. It consists of an iron core with holes near the circumference, through which are placed copper rods which are securely bolted to rings at each end. The currents in this element are induced through magnetic action from the currents in the coils on the outer stationary part of the machine which are received from the supply circuit. The induction motor tends to run at a certain definite speed and falls off a trifling amount from this speed as it is loaded. The synchronous alternating current motor must run at a perfectly definite speed, and when the speed falls below this amount, caused by overload or otherwise, the motor will stop. It is much more sensitive in its operation and requires closer adjustment and attention, both mechanically and electrically, than the much more flexible induction motor.

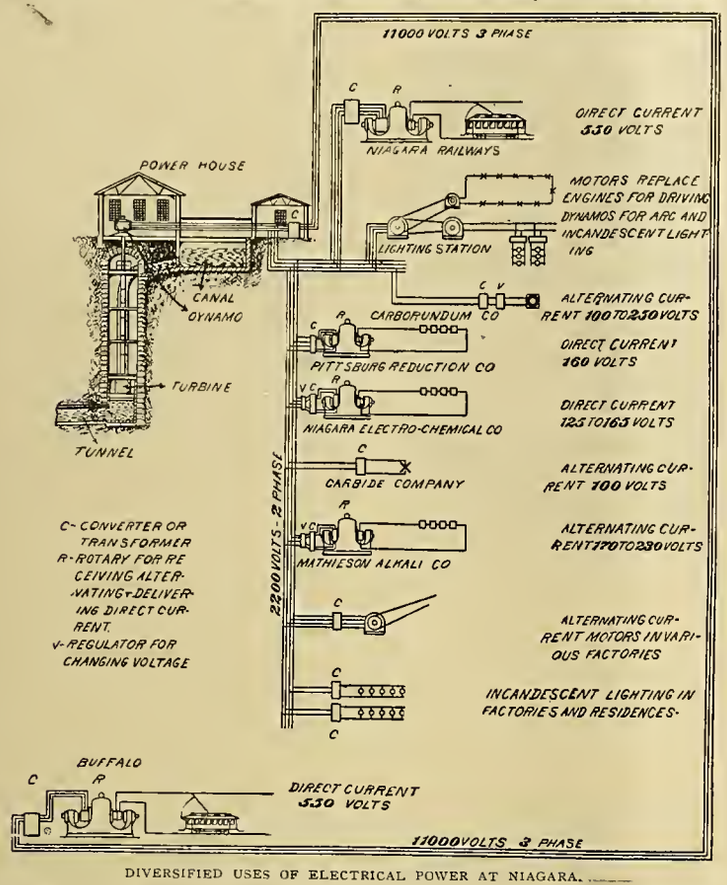
Mechanical power is supplied from Niagara circuits for various minor operations, such as driving fans, pumps, crushers, etc., in connection with the various establishments which have already been described.

The only present use of mechanical power on a

FIG. 2. ELECTRIC WAGON HAULAGE IN FOUNDATION BUILDING.

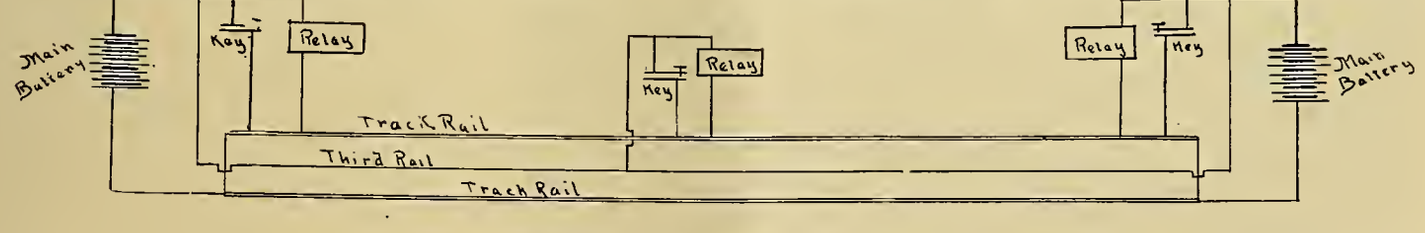
large scale is in the operation of street railways. Direct current at a pressure of about 500 volts is obtained for this purpose through the agency of transformers for reducing the pressure of the main circuits and rotaries, which are similar to the machines at the various chemical works which receive alternating and deliver direct current. Three machines of 500 horse power each are located in one end of the power house and supply current to the railways in Niagara Falls and to the Niagara end of the road to Buffalo.

We have now completed our examination of the

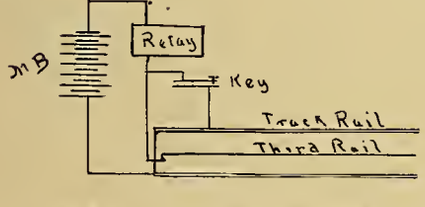


DIVERSIFIED USES OF ELECTRICAL POWER AT NIAGARA.

diversified methods of using electric power near the generating plant. The feature, however, which attracts the greatest popular interest is the transmission to Buffalo. In the transformer house are two transformers, with a total capacity of 2,500 horse power, which transform the 2,200 volt two-phase current into 11,000 volt three-phase current, which is carried by three heavy copper cables on a substantial pole line to the outskirts of Buffalo, where it passes into cables in an underground con-



THE ROYSE SYSTEM OF TELEGRAPHING FROM MOVING TRAINS.



THE ROYSE SYSTEM OF TELEGRAPHING FROM MOVING TRAINS.

duit to the power station of the city railway plant, a total distance of 27 miles. Here the current is reduced in pressure, is transformed into direct current and supplies about 1,000 horse power to the trolley circuits. It is proposed to increase the transmission voltage to 22,000 volts and supply power on a large scale for general purposes as soon as the apparatus can be installed.

Mr. Scott's paper was briefly discussed by Dr. Coleman Sellers, who said:

It has afforded me much pleasure to follow Mr. Scott's description of the work of developing the power of Niagara Falls, particularly his statement of the electrical conditions and explanation of the mode of meeting the requirements of the problem.

He has called attention, I notice, to an important improvement in the transmission of electricity. From two-phase generators which need four cables for such transmission he has explained how, by conversion into three phases in the step-up transformers, three cables only are required to form the line, thus saving 25 per cent. in copper and the same amount in the number of insulators needed. He modestly refrained from connecting his own name with this important invention, which he made public at a meeting in Washington, D. C., when the study of the subject for the Cataract Construction company was exciting the inventive faculty of competing electrical manufacturing companies.

Mr. Scott's use of the two-throw cranks analogue in explaining the advantage of two-phase generation has been enhanced by his ingenious comparison of the principle of the step-up transformer to short radius cranks with heavy connecting rods receiving the power from the prime motion, while long radius cranks and lighter connecting rods for the transmission of the power to a distance is new to me and must be hereafter associated in my mind with others of his happy thoughts.

In following the rapid progress in the art of generating and transmitting electricity I have had repeated conferences with the technical staff of the leading companies engaged in manufacturing electrical appliances, and as I am familiar with what they have done to advance the art, I can fully appreciate Mr. Scott's contribution to this advancement by economical methods, and recognize his part in the inventions he has briefly mentioned this evening.

In regard to the fact that the turbines at Niagara Falls were designed by foreign engineers, it may interest you to know something of the circumstances that led thereto. Certain fixed conditions and requirements were submitted to turbine builders both in this country and in Europe. At the recommendation of the Niagara Commission that met in London in 1890, a unit of 5 000 horse power had been adopted under the available head of 136 to 140 feet, and a speed of 250 revolutions per minute was prescribed. No turbine of 5,000 horse power had been built by any manufacturer, and none of the commercial sizes of turbines on the market could be utilized. A new design was therefore required to meet the conditions and many plans were submitted. The design of Messrs. Faesch & Piccard of Switzerland proved to be the most acceptable and was accordingly adopted. This firm had previously designed no turbines of over 700 horse power, and the nature of the problem as presented required much study and could be met only by wide departure from common practice.

While designed abroad, the turbines and machinery connected therewith were built in this city, and, so far as the operation of the wheels themselves is concerned, we have every reason to be satisfied with our choice. Some radical changes had to be made in the few bearings needed to steady the revolving shaft, for while designed in accordance with the best European practice they did not meet the conditions, and were therefore modified on lines well established by long experience in America, but not familiar to all engineers. More than 30 years' experience in manufacturing shafting enabled me to design the bearing that has been so successful in the present case. The construction of the turbines was well under way before any conclusion had been reached as to the character of the electrical system to be employed. The dynamos were not ordered until 1893, and at that time little was known as to what uses the power developed would be applied. Mr. Scott has explained to you that the system adopted was considered by experts as best adapted to power purposes. This differs in many ways from what, to a limited extent, was then in use in operating machinery by direct-current motors. He has explained by diagram the perfect elasticity of the multiphase alternate current system, and the great scope of its economical utilization. With this in mind, you can well appreciate the value of the selection, considering the paucity of data at command to aid in designing the power house and in anticipating the character of the appliances to be accomodated therein.

At the present time the wheel-pit and power house at Niagara Falls are being extended, and new machinery is well under way. Five units, each of 5,000 horse power, will be added to the three now in operation. The extension of the machinery is in harmony with the present plant, which was considered experimental by most engineers. A careful study of the operation of the turbines and of the dynamos has enabled improvements to be made in the direction of simplicity and increased durability. The efficiency promised by the makers of the existing plant was deemed by many engineers as problematical. For the new machinery a higher efficiency is guaranteed, and I have confidence in the result. The new dynamos will not differ in outward appearance from those in use, the changes being mainly in the armature for the diminution of copper and iron losses and more perfect ventilation.

The present dynamos are excited from steam-driven direct-current generators, or can be self-excited from rotary transformers. In the extended plant the excitation will be from direct-current dynamos, driven by special turbines of American design, arranged in a group in the middle of the long line of dynamos, which thereafter will be operated wholly by water power. The anomaly of so large a water power being dependent on steam for its ability to generate electricity will thereafter cease to obtain in practice, as sufficient direct current will be generated from turbines to excite the fields of 10 dynamos and also operate such direct-current motors as are required in the house and to supply all arc lights used on the premises.

The Royse System of Telegraphing from Moving Trains.

There was on exhibition last week in the First National Bank building, Chicago, a rough model of a new system of telegraphing from moving trains. The inventors are Clarence D. Royse, a telegraph operator of Greencastle, Ind., and his brother, W. A. Royse, an Indianapolis newspaper man, who was in charge of the model. The system requires a light insulated third-rail or electrical conductor of some sort laid between or adjacent to the track rails. Rubbing or rolling contacts are attached to one or more cars of each train, and the electrical circuit is made through the instruments on the train to a track rail, which serves as one leg of the circuit.

The method of wiring is interesting, and may be traced by the accompanying diagrams, which show the theoretical construction of the system. The larger drawing gives one method of wiring and the small drawing shows how instruments at terminal stations may be connected. The two sets of batteries are connected in reverse order; that is, the like poles of both batteries are connected to the third rail and the other poles to the running rail, or ground. While this makes a complete metallic circuit, there will be no current in the line, for the line

will be at zero potential. The relays are connected between the third rail and the running rails in multiple; i. e., one wire connects with the third rail at any point and the other wire from the relay connects with the running rail. These relays are of a very high resistance, and, although they are connected directly with the two legs of the circuit, they cannot take the full current from the third rail. It will readily be seen that, with this arrangement, a suitable connection will cause two complete electric currents to flow from the two sets of batteries. It will also be seen that the connections of all relays are practically the same. The current, in passing through the relays, encounters a high resistance, and therefore only a small portion of the entire current will pass through the relays. Now, if any key, all being connected as shown in the drawings, be closed, it will offer a direct passage through the closed key for the entire current, short-circuiting all the relays. The armatures of the relays then drop back from the magnets and this action of the relays closes all sounders. When the key is opened again the sounders all open, completing the electric signal.

Each car will have a revolving metal brush on each truck of the car that carries the telegraph instruments. This is so that when one brush is not in contact with the third rail the other one will be. These brushes carry the current from the third rail to the telegraph instruments, and the current is returned through the truck of the car to the running rails. It is the reverse battery that makes the working of the system possible. Without that there would be no effect on the instruments under this kind of wiring.

The advantages of telegraphing from moving trains are obvious. Were the train dispatcher able to communicate instantly with any train traveling over his section of road, collisions ought to become very infrequent, if not cease altogether.

The Drosophore.

The question of humidity in the atmosphere of some classes of workshops, especially those where the manufacture of textile fabrics is carried on, has been a puzzling problem and one that has been only partially solved. Steam mingled with the atmosphere has given some relief, but it has at the same time been in a degree objectionable, even in the coldest weather.

There is also another class of industries which is greatly interfered with in dry, cold weather by static electricity; namely, the paper industries. It is not unusual for sheets of paper to adhere to each other in printing offices, binderies and similar places so that they will tear in separating.

The static charge constantly accumulating on belts driving all kinds of machinery is also an annoyance, especially as the sparks from them are looked upon as a fire hazard by the insurance people.

To remedy this class of disturbances an ingenious invention, known as the drosophore, has been in use for some months, according to La Nature, in Amiens, with excellent success.

The apparatus consists of two systems of pipes, shown in the illustration, Fig. 1. The upper one, the inlet pipe, properly governed by the stop-cock shown, has two discharge pipes, in opposite directions, so placed that two fine streams of water are thrown up and down against each other, breaking the liquid into most perfect foggy spray. But the downpouring stream, being of greater capacity, forces the washed air against the cone below, whence it is deflected outward into the air next the ceiling. As this is a trifle heavier than the surrounding atmosphere, it sinks, carrying with it an imperceptible moisture, just sufficient for the purpose of dampening the textile fabric, paper or other material as required.

The superabundant water is now drained away by the second or lower pipe. Fig. 2 shows a press-room in which the drosophore is in operation.

During the heated term the temperature of the air is reduced by the humidity, while in the colder seasons of the year the water used is of a higher temperature, and serves the double purpose of moistening and warming the air at the same time.

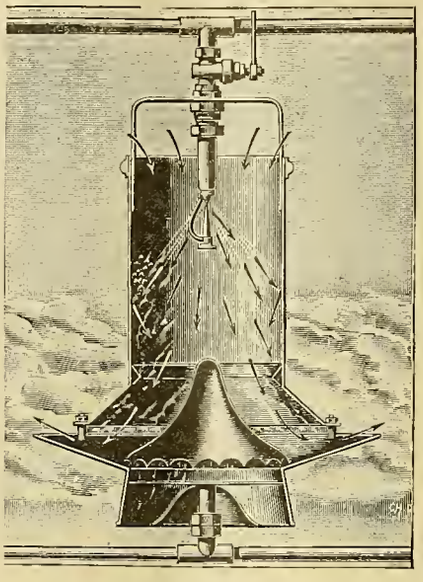


FIG. 1. THE DROSOPHORE.

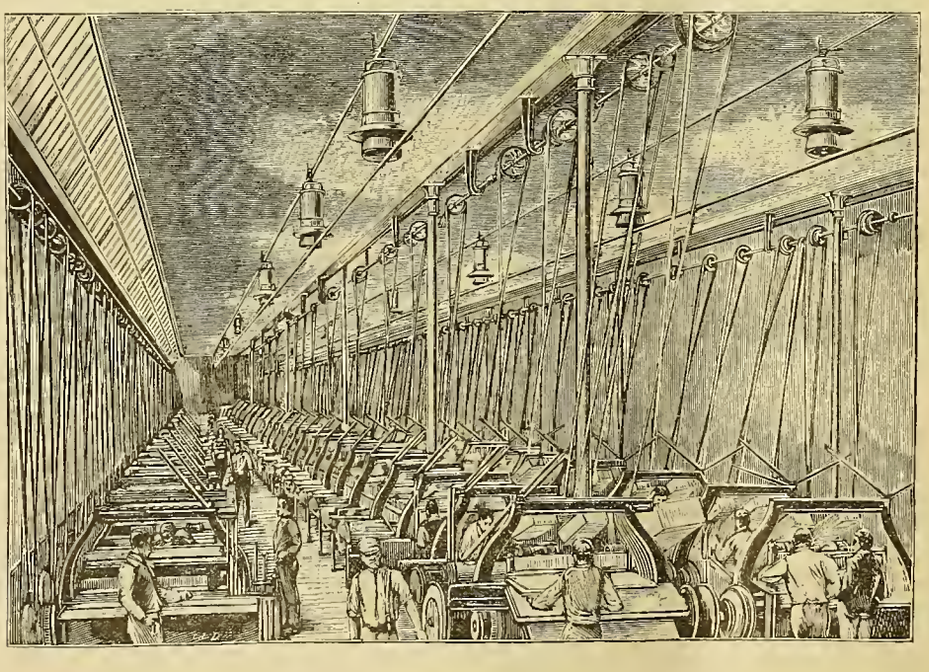


FIG. 2. THE DROSOPHORE.

Economy and Utility of Electrical Cooking Apparatus.[1]

By John Price Jackson.

The tests of electrical cooking apparatus detailed in this paper were made with the hope of obtaining a method of cooking that would be satisfactory with a minimum risk of fire. During the past winter a serious fire, which might readily have become disastrous, occurred in one of the buildings of the college with which the writer is connected, caused by the use of an alcohol stove. As this institution is lighted and furnished with power by electricity, it was naturally felt that such a danger should be avoided, if possible, by the use of electrical appliances. It was also desired to find out whether at least a portion of the cooking in the woman's department of the college could not be done satisfactorily by electricity.

To settle these points, I procured from the American Electrical Heating corporation of Boston (through the courtesy of Mr. Sayles) the following pieces of apparatus:

One oven, 12 inches by nine inches by 15 inches, having three heats, three, 10 and 17 amperes respectively.

Three stoves of two, four and five amperes respectively.

Two flatirons of 1.5 and six amperes capacity.

One broiler of 12 amperes capacity.

The pressure used by these is 110 volts.

The stoves are round disks of iron, on the under side of which the heating wires are imbedded in a non-conducting, non-combustible compound. The oven is a box, so thoroughly heat-insulated that the outside metal covering never reaches a temperature uncomfortable to the hand. The broiler is made of a corrugated metal surface, slightly tipped from the horizontal, with a drip groove at the lower edge for catching the meat juices. The flatirons are similar in construction to the stoves, the larger one having a low heat switch, which enables the operator to control the heat.

In all these appliances the heating coils are so arranged that the energy is largely concentrated at useful points. They are also supplied with supports and cases which will not conduct heat.

The efficiencies of the two larger stoves were obtained by heating two pounds of water to the boiling point and measuring the power supplied by a calibrated wattmeter. The cooking vessels used were ordinary stewing pans, with the bases nearly the same size as the tops of the stoves. The efficiencies, considering the ratio between the amount of heat absorbed by the water and the amount received by the stove, were:

For the larger or No. 1, 48.9 per cent.

For the next size, No. 2, 43.1 per cent.

These efficiencies could be increased by having the pans made to fit the stoves exactly, and still further by carefully covering the pans, lids and exposed portions of the stoves with a non-conductor of heat.

When it is desired to boil water, the best plan is to place an immersion coil in a properly heat-insulated pot; such an arrangement should give an efficiency of from 90 to 100 per cent. We unluckily did not have such a coil at our disposal.

It was impossible to measure the cooking efficiency of the oven, but as it was merely warm on the outside after potatoes or bread had been baked and "done to a turn," the efficiency is high. In baking, the current was turned on and the oven allowed to heat for five minutes before the articles to be cooked were placed within, and the current was turned off from 10 to 20 minutes before the baking was done, when the heat of the oven was sufficient to complete the operation. The broiler was manipulated in much the same manner, thus utilizing the greatest possible amount of heat. This electrical apparatus was used in cooking most of the meals for a family of six for several weeks.

The following table indicates the amount of cooking done for the first breakfast, dinner and supper, respectively, and may be taken as a fair average of the whole period.

All costs have been estimated on the basis of 10 cents per kilowatt-hour, the average rate charged for residence electrical supply in a near-by town. The foods were not measured, as it was believed more desirable to determine whether in a long period of cooking the apparatus would prove satisfactory in a family of given size.

The largest stove is designated No. 1; the next size, No. 2; the third size, No. 3; the broiler, B, and the oven, O.

BREAKFAST.

Time.	Utensils.	Food.	Watts.
6.55	No. 1, oo	Rolled oats	
6.55	2, on	Coffee	844
7.45	2, off		
7.45	B, on	Beefsteak	1,500
7.55	2, off		1,755
8.05	B, off		

Kilowatt-hours, 1.355. Cost, 13.55 cents.

DINNER.

10.25	No. O, on	Roast beef, Potatoes, Pie	1,610
10.35			
11.14			
11.46	1, on	Asparagus	1,990
12.05	O, off		
12.05	2, on	Coffee	1,180
12.11	B, on	Toast for asparagus	2,200
12.29	1, off		1,835
12.32	B, off		
12.32	2, off		

Kilowatt-hours, 2.98. Cost, 29.8 cents.

SUPPER.

4.59	No. 1, on	Cocoa	630
5.15	2, on	Potato cakes	1,010
5.10	B, on	Omelet	2,100
5.22	2, off		1,700
5.26	B, off		
5.26	2, on		1,130
5.43	2, off		
5.44	1, off		640

Kilowatt-hour, .839. Cost, 8.39 cents.

Four pies can be baked in the oven at an expenditure of .62 kilowatt-hour and a cost of 6.2 cents or 2.05 cents per pie. Two large loaves of bread were baked with the current on the oven 50 minutes, at an expenditure of 1.22 kilowatt-hours, at a cost of 12.2 cents or 6.1 cents per loaf. Four rather small-sized loaves could have been as readily baked. Biscuits with about the same expenditure of energy as in the case of pies. The broiler utilized about the same amount of energy for all kinds of meat as indicated in the table.

The result of the whole series of meals was a cost for electricity of 13.1 cents per meal. The heating of water for washing the dishes took an

1. Read at the fourteenth general meeting of the American Institute of Electrical Engineers, Eliot, Me., July 26, 1897.

additional .35 of a kilowatt-hour per meal, which raises the cost to 16.6 cents per meal.

To determine the relative cost of cooking with electricity and coal, the same foods were cooked on the No. 8 Othello coal stove ordinarily used by the family. The coal was carefully weighed. The results gave an average of 12.6 pounds per meal, which at $5 per ton gives a cost of 3.15 cents per meal.

The results show the cost of cooking by coal about 19 per cent. of the cost of cooking by electricity.

Ironing was done for the same household a number of times. The heavy articles were done with the large iron, while for fancy dresses and small articles the small iron was used. The average time taken was four hours, and the expenditure of energy in kilowatt-hours was 2.27. This made the cost of the ironing 22.7 cents.

A equal number of tests was made using the coal range, the fuel being carefully weighed. For the same size wash, the ironing took five hours, at a cost of 12.25 cents. This shows the cost of energy by the use of coal to be 54 per cent. of that by electricity.

The results of the cooking tests seem to indicate that for the ordinary cooking of a family for the whole year the expense would be larger than would be ordinarily acceptable, notwithstanding the great advantages in other respects. However, in the following classes their utility should be great:

1. For light housekeeping, such as is practiced in small city apartments, or in many larger houses during the summer months, no other method presents so many desirable features. The dirt of coal and ashes, disagreeable gases and abnormal temperatures due to a coal stove are entirely obviated. For such housekeeping a disk stove using 500 or 600 watts and a broiler using about 1,200 watts would be sufficient for a small family and would cost from $20 to $30. A teakettle or immersion coil might be added at a cost of from $6 to $10. A special pair of wires would of necessity have to be run into the cooking room from the house or apartment supply mains. The latter would ordinarily warrant the extra call that would be made upon them in this way. For similar purposes coal-oil, gas or gasoline are frequently used, but with the inherent disadvantages of greater heat in the room, offensive odors, comparative uncleanliness and danger.

2. This form of cooking apparatus could be used with facility in boarding houses and restaurants for purposes which require an even temperature, such as is needed in baking griddle cakes, boiling eggs, etc.

3. Where electricity is available, nothing could be more convenient than a small electrical stove, requiring 300 or 400 watts, for the many uses to which at present the alcohol flame is put, such as the afternoon teakettle, chafing-dish, toaster, etc. This use of alcohol is most unsafe as regards danger from fire, and could well be discarded for electricity, which is absolutely safe when properly installed, as well as being more convenient and better in other respects.

4. In the shop, the glue pot, solder pot, brazing iron, etc., can be heated advantageously by electricity, and one of the most gratifying consequences of our experiments has been the decision to put such an equipment in our college shops.

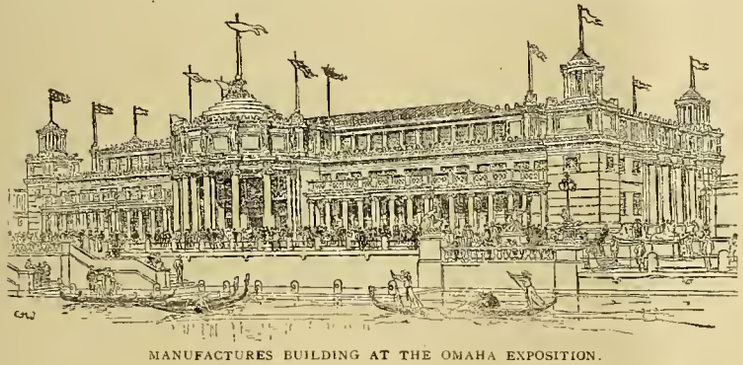
5. The test of the electrical flatirons showed them more economical than the old form, when the saving of labor is taken into account. Not only is there a saving in time, but the severity of labor is much lessened. Our experience was that a laundress who had used an electrical iron would be exceedingly unwilling to go back to the old form.

A small flatiron of two or three amperes attached to the ordinary lighting fixture in a dressing room is a great convenience, and with an electric teakettle and curling-iron are destined to become essentials in the modern home.

Concerning the questions whether the use of electricity had proved satisfactory in its operations in the cooking tests described, the housekeeper in charge said: "The instruments were excellent in every respect. We were able to cook more rapidly, to keep the heat at just the right point, and could readily prevent overcooking or undercooking. While we were using electricity every dish was perfect. When I think of these advantages and of the cleanliness and convenience of the utensils. I sincerely hope that some of them at least may be retained in the house permanently."

The general results of the tests were of such a nature that the writer is warranted in the belief that if central station managers would more generally introduce exhibition equipments of these domestic utensils, a new call on their station capacity would develop, of which the larger proportion would be during the light-load periods.

I wish to acknowledge my indebtedness to Rudolph F. Kelker of Harrisburg, Pa., for his valuable aid in carrying out the work thus briefly described.



MANUFACTURES BUILDING AT THE OMAHA EXPOSITION.

Guyomard and Rolland's Microphone.

This invention comprises an innovation in microphones, which is the result of much study, and it is claimed is a very perfect instrument for its purpose—that of telephonic transmitter. While the first instruments were adapted to the form known as the Ader transmitter, Fig. 1, the later apparatus is adapted more especially to the Bert and d'Arsonval form, Fig. 2, which differs principally in the hooking arrangement, about which there has been so much legal controversy in this country.

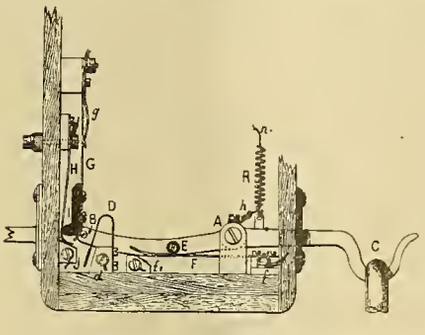


FIG. 1. GUYOMARD AND ROLLAND'S MICROPHONE.—HOOK ATTACHMENT—ADER TELEPHONE.

The novelty of the new apparatus consists in a peculiar arrangement of the carbons, with a view to eliminate the scratching sounds so common in microphones with movable carbon.

The microphone, Fig. 3, comprises four carbon pencils C, C', C'', C''', arranged vertically in cups hollowed out of the horizontal carbon prisms P, P', P''—these last being bolted on a fir board.

The cylindrical carbons form with the prisms P, P', two groups, in each of which the two carbons are mounted in derivation. These two groups are installed in series, by contact through P''' at the top of Fig. 3.

The line wires are brought to the carbons, P, P', to which they are attached by set screws in the bolts which confine the carbons to the backboard A.

The peculiar finish of the extremities of the carbons is novel. Each extremity of the movable carbons is channeled, the object being to lessen the displacing or trembling of the carbons in a lateral direction, vibrations which are secondary in their character and interfere with the clear-cut nature of the primary sounds. There is also this advantage: that the sticking of the cylinders to the prisms is prevented, and the powdered carbon which wears off the contact surfaces is also prevented from accumulating in the bottom of the cups, as it escapes readily through the grooved surfaces and drops out of the perforated bottoms of the cups.

The regulation of the microphone is accomplished through the spring blades R, R', R'', R''', shown in front of the carbon cylinders, Fig. 3. The free ends of these springs rest upon the lateral surface of the corresponding carbon, and to prevent the possible metallic vibration which may result, and also the wear of the carbon, a cushion of rubber or felt, c, c', c'', c''', is interposed at the point of contact.

These springs are solidly fixed at their bases to the brass rod T by a pin. This rod is movable by the screw V, which is capable of regulating the pressure, and thus adjusting the carbons.

This screw V formerly reached from the outside of the box, was constantly tampered with, so that in all the later instruments the manufacturers have placed it wholly within the case, but a pointer on the outside of the box indicates the amount of pressure.

The adjustment is claimed to be delicate and easily arrived at, and the instruments have attained a marked popularity wherever used in France. The illustrations and data are from l'Electricien.

Manufactures Building at the Omaha Exposition.

Readers of the Western Electrician will be interested in the accompanying picture, which shows what the manufactures building at the Trans-Mississippi Exposition will look like. This exhibition

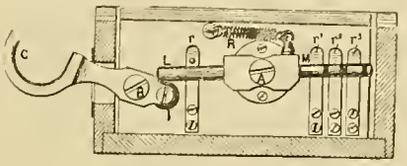


FIG. 2. GUYOMARD AND ROLLAND'S MICROPHONE.—HOOK ATTACHMENT—BERT-D'ARSONVAL TELEPHONE.

will be held in Omaha next summer, and promises to be especially rich in electrical attractions.

The manufactures building is characterized by the Greek Ionic style of architecture. The order is of heroic proportions, carried out with artistic care in every detail. The principal feature of the lagoon façade is a circular dome 150 feet in circumference, rising to a height of 75 feet. The dome is supported on a circular row of fluted Ionic columns, and the space enclosed by them and under the dome is open, forming a grand vestibule for an approach to the building. The inner dome is richly designed with ribs and panels and is to be decorated in colors, while the outer is formed by a series of steps rising in the form of a cone to the apex, which is crowned by a richly decorated base for a flagstaff. The outer row of dome columns is detached and the entablature is broken around them at the base of the dome, and over each column is a statue and pedestal, having as a background the stylobate of the dome. This treatment is very monumental in effect, and while in good taste and harmonious with the architectural style, it is at the same time original and interesting. Over the doorway leading from this vestibule into the building are three large panels between the pilasters to receive paintings which will be emblematical of the character of the exhibits. Flanking the central dome are beautiful Ionic colonnades which form covered ways along the entire façade, stopping at the corner towers. Over these colonnades are balconies capable of holding large numbers of people and opening from the interior galleries of the building, affording a fine point from which to obtain an elevated view of the lagoon and the beauties of the grand central court. The four corners of the building are marked by square plain towers surmounted by ornate, open, columned pavilions, circular in form and to serve for electric lighting. The manufacures building will be 300 feet long and 140 feet wide. It was designed by S. S. Beman of Chicago.

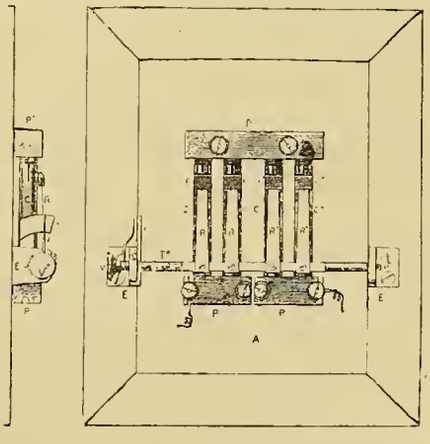


FIG. 3. GUYOMARD AND ROLLAND'S MICROPHONE.

Buffalo's Water Supply.

[From the Buffalo Express.]

The commissioners of public works believe that electricity is the pumping power of the near future. They think that the proposed new pumping station should be equipped with electric engines. But the 30,000,000 gallon pump, bids on which already have been submitted, must needs be of the steam variety, inasmuch as the Buffalo Engineering company, the bidders, are unable to make satisfactory arrangements for electric power just at present. So the contract goes to the Lake Erie Engineering Works, the lowest bidder on steam pumps. It is a pleasure to know that the construction work will be done in Buffalo.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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With the Niagara Falls convention number of the Western Electrician, dated June 12, 1897, this journal made a new record for itself both in circulation and advertising. Of this 100 page number 20,000 copies[1] were printed and circulated and the amount of full paid advertising matter carried was 8,643 square inches.

1. State of Illinois, County of Cook—ss:
Frank Foster Kenworthy being duly sworn deposes and says that he is a resident of the city of Chicago, in the county of Cook and state of Illinois, and that he is the superintendent of the binding department of the Electrician Publishing company, the publishers of the Western Electrician; that he was present at and superintended the binding of No. 24 of Vol. 20 of the Western Electrician, issued on June 12, 1897, and that there were sent out by actual count 20,000 complete copies of said Western Electrician of the volume and number above specified.
And further this affiant sayeth not.
FRANK FOSTER KENWORTHY.
Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

Beginning with the convention number of March 3, 1894, the record shows constant gains each year until in the present case the number of square inches of full paid advertising matter is more than double that of the 1894 number. The figures showing this unprecedented gain are given in the accompanying table:

Issue	Number of Advertising Pages.	Whole Number of Pages.	Square Inches of Paid Advertising Matter.
March 3, 1894	40	56	4,145
February 23, 1895	52	68	5,593
May 9, 1896	72	88	7,576
June 12, 1897	80	100	8,643

This constantly increasing patronage speaks eloquently of the influence and merit of this journal and of the confidence and respect which it commands throughout the country. It is pleasing recognition of the efforts that have been made in the interest of the entire fraternity.

In England some of the electrical men propose the organization of a league of cricket clubs composed of men from the central stations and electrical factories. This is much more sensible than the ridiculous plan of having a corps of Volunteers composed entirely of electrical engineers. Let honest sport take the place of silly martial bluster.

Alderman Mangler has testified before the grand jury that he was offered a bribe of $2,000 for his vote in favor of the General Electric Railway company's ordinance changing the proposed system from underground to overhead trolley, and Henry Brandenburg has been released from custody in spite of the sworn testimony of Lucius Clark that the signature to the transfer of stock in dispute was not his and that it must have been forged by Brandenburg. Under the circumstances the General Electric Railway company cannot expect to enjoy the confidence of the community. No wonder every announcement emanating from that concern is viewed with suspicion.

The London electrical papers are congratulating themselves upon the successful issue of their movement against F. S. Pearson, the American engineer, whom it was proposed to place in charge of the building of the Liverpool electric roads. Mr. Pearson has relieved the tramways committee from all embarrassment in connection with the question of his appointment as consulting engineer. The committee received a communication from Mr. Pearson intimating that his numerous contracts preclude him from accepting any position under the corporation, even in a consultative capacity. It was intimated that Dr. Hopkinson's services would be secured, but later it was announced that Granville C. Cunningham and H. Graham Harris will probably be appointed as engineers. One of our contemporaries says: "We are glad, not from any personal motives, as we have already stated, but because we feel so strongly that charity should begin at home—in other words, that while we have the men capable of doing the work there is no need to go out of the way to appoint men from foreign countries. We were sure that if the matter was placed before the Liverpool people in the proper light, they would agree with the justice of our view, and therefore we did not hesitate to speak plainly; and we are rejoiced to find that our view has prevailed." Mr. Cunningham hails from Montreal and Mr. Harris is a general engineer without any special experience in electric railway work. Yet the English papers are happy, merely because an American engineer will not enjoy the honor of putting in this important work.

Negligence in insufficient or defective bonding of a street railway track was charged in suits brought for the recovery of damages alleged to have been sustained therefrom by injury to a valuable horse and of a person thrown from the carriage in the resulting runaway. On appeal, it was contended that, as the averments of negligence were limited to the bonding of the rails, the plaintiffs were obliged to point out and establish some particular defect or insufficiency in such bonding. But the Court of Errors and Appeals of New Jersey held otherwise, in a case in which the Trenton Passenger Railway company was interested. It says that it would have been sufficient to aver that electricity was, through negligence, permitted to escape from the rails; but, as it appeared in the case that such escape was only possible at the ends of the rails, it was a necessary conclusion that, if it occurred, it must have been due to insufficient or defective bonding. It must be assumed, continues the court, that with proper and sufficient bonds the rails would have carried a current of electricity with safety to horses stepping upon them, otherwise the operation of the railway in a public street by means of such a current passing through its rails was by the mere fact itself a nuisance. No legislation has authorized such an infringement on the rights of the public in a highway. If, therefore, electricity did escape from the rails, that fact was presumptive proof of negligence. Or, as the court expresses it in the syllabus which it prepared, escape of electricity from a street railway, to the injury of a horse being driven on a public street, is presumptive proof of negligence in the operation of the railway. On the other hand, the court says that, of course, proof of a latent defect or of a break in a bond, of which the managers of the railway could not with due diligence have learned, might rebut the presumption of negligence.

Time was when the idea of eating one's breakfast in Chicago and dining in New York was attractive because of the novelty of the proposition, but at no time has it been seriously considered as practicable, yet there are crack-brain inventors and enthusiastic promoters who periodically revive the scheme and get some gullible newspaper to publish their "plans." The latest victim of this class is the Chicago Tribune, which is old enough to know better. That journal published in last Sunday's edition a highly sensational story of a project for operating trains between Chicago and New York in nine hours. "The project would appear ridiculous," says the Tribune, "were it not for the indorsement given it by electricians of high standing. These assert the project is not only practicable, but the speed limit set by the promoters is far below what can be safely and surely reached by the aid of Tesla's genius in harnessing the alternating current." Inasmuch as "Tesla's genius in harnessing the alternating current" has nothing to do with the problems involved in high speed railroading, the project continues to appear ridiculous and so does the Tribune in presenting it.

Concerning the work already done, the Tribune says: "Trains which the most powerful engines of the company [the B. and O.] could barely move were readily handled by use of the electric motor." This, of course, is all bosh. Another statement is equally interesting: "One apparently insurmountable trouble has been the power house problem. Direct currents of 500 or 600 voltage require power plants within close touch. With alternating currents, harnessed by the Tesla system, these power houses may be 50 miles apart, and this distance is even now in a fair way of being extended to 100 miles." Why use power stations at all? Cannot "Tesla's wonderful genius," or, more properly speaking, the remarkable imagination of the Tribune reporter, devise a system that will not require generating plants and wires? But this is not all. It appears that "the engineers' plans, which are now awaiting the indorsement of the board of directors, make the road run in an air line from Chicago to Jersey City by way of Buffalo and Cleveland. There will be no curves to derail trains, and to guard against the possibility of cars jumping the rails when going at full speed an ingenious contrivance which locks the wheels to the tracks is to be provided."

In order to reach New York by a straight line from Chicago it will be necessary to cross portions of Lakes Michigan and Erie, but such trifling obstacles as these will not be permitted to stand in the way where so much genius is on tap. However, it may be remarked that it will certainly require "an ingenious contrivance" to "lock the wheels to the track" and operate trains at a speed of 100 miles an hour.

Work of the Patent Office.

Major Butterworth, commissioner of patents, has recently made a report of the business of the United States Patent Office for the year ended June 30th. He shows that there were received in that period 43,524 applications for patents, and that 23,994 patents were granted, including reissues and designs. The number of patents which expired was 12,584. On July 1st 12,241 applications were awaiting action in the Patent Office. This is a larger number of pending applications than has ever been reported before. The total receipts of the year were $1,343,779.44. The excess of receipts over expenditures was $317,135.05, and the total balance in the treasury of the United States to the credit of the Patent Office amounts to $5,093,614.23.

The commissioner comments on the condition of business in the office in the following terms:

"A greater number of applications for patents were filed during the year 1896 than in any previous year in the history of the Patent Office, and yet the number filed during the first six months of 1897 has exceeded by more than seven per cent. the number received in the first half of 1896. From Januray 1, 1897, to June 30, 1897, there were filed 25,559 applications. During the same period the total receipts of the office were $722,897.47, a gain of $102,015.50 over the six months immediately preceding. A comparison of the same periods shows an increase of about six per cent. in the number of patents granted, and a like increase is shown in the number of assignments recorded and certificates issued. During the same period in 1896 there were sold 334,931 printed copies of patents, while in 1897 there were sold 679,483 copies, or an increase of nearly 103 per cent. during the first six months of the present year. The increase in the number of copies sold has not, however, resulted in the material reduction in the space occupied by these records which was expected when the price of the copies was reduced.

"While it was reported that on June 30, 1896, there were 8,943 applications before the office awaiting its action, during some weeks prior thereto, during all of October and November of that year, and at other periods the number exceeded 10,000; but, beginning with February, 1897, and continuing to the close of June, 1897, a steady increase was maintained until the applications pending for action on the part of the office reached the number of 12,241, reported in the above table. By constant and diligent effort by the examining corps the number has since June 30th been brought down to about the number in arrears in the fall of 1896. In crowding the work, however, it occurs that the examinations may not be as thorough as they ought to be, and inasmuch as inventors have provided a fund ample to employ a force sufficient to insure efficiency and promptness in the dispatch of business, it is submitted that the appropriation of the fund so provided should be adequate to the just requirements of the bureau. It is not probable that the number of applications on hand could be brought or kept below 10,000 with the present force of the office, even under the rushing process, if there were no increase over 1896 in the receipts of applications. The field of search, especially among foreign patents now accessible to this office, has greatly increased during the last few years, and the character of the work is such that it is impossible for the examining corps, in which there has been no increase since 1891, already pressed to its utmost capacity, to reduce the volume of work and do the work properly. With the indicated increase of applications the work must continue to fall further behind unless relief is afforded."

The Missionary City of Dunshalt.

William Arthur of 403 West Twenty-eighth street, New York, seems to be a reformer of reformers. He has many ideas for the betterment of mankind, and he expresses them in a language of his own contrivance, which he styles "Neu English" and which is principally distinguished by spelling which is so far advanced, phonetically, that it forms an interesting puzzle to him who is merely proficient in old, every-day English. Mr. Arthur is an advocate of the establishment of a model city in the state of Arkansas, and he has drawn up, evidently with great pains, a "speshal aurdinans"—which seems to be a sort of charter—for the proposed community. This instrument has been published by Mr. Arthur as a 32 page pamphlet, and someone has kindly sent a copy to delight the Western Electrician. The charter is reminiscent of the work of the late Josh Billings in orthography, but it shows that Mr. Arthur is a man of ideas at any rate, and although his plans are visionary, the whole scheme seems to be put forth in good faith to make men and women happier—under the benevolent tutelage of William Arthur.

A few sections of this fantastic "aurdinans" will be of interest to the readers of this journal.

"§ 31. No franchizez shal be granted faur eni purpus. The siti shal oen and operait—not lees—aul such natyooral monopoliz az street karz, wauter wurks, elektrik leiting, gas wurks, etc., etc. Hwen neumatik teubz ar poot in, the siti onli shal yooz them to do such expiesing az kan be karid in thair deiameter. The R. R. terminal sistem shal aulso be oened bei the siti. The raits to railroedz yoozing onli Neu Inglish shal be ten per sent. cheeper than to thoez yoozing the oeld speling.

"§32. The Poest Ofis must be in the senter ov the siti, and so bilt that the karz kan run direktli into it. If the siti erekt an expres bilding faur its oen yoos, it must be neer the sentral R. R. staishun and the P. O.

"§ 33. The siti must hav subwaiz faur peips ov aul keindz, faur weirz, seurz, etc., and proper konckshunz to eech lot must be maid befoer the paiving iz laid in aurder to avoid oepning the street. The seuej ov the siti must not run into eni streem.

"§ 34. Wauter, gas, elektrisiti aur enithing supleid bei the siti must be soeld at the saim preis to rich and poor. Thair mai be a distinkshun between supleiz faur domestik and manyoofakiuring purpusez, but in eech klas the preis must he the saim hwether the amount yoozd iz kounted az ten aur ten thouzand.

"§ 35. The konduktorz in street karz shal not wair punchez aur rejisterz, and thai shal not be yoozd on the karz. Men on street karz aur neer masheeneri shal not smoek sigarets. The street karz shal not run on Sundai unles it iz so deseided bei feiv-aitths ov the voeterz."

Many other curious "sekshunz" might be cited, but one must suffice:

"§ 57. Aul planz maid must be in the Metrik sistem. Aul wurkerz shal yooz the Metrik sistem. Az far az posibl the termz yoozd shal be thoez aproovd bei the authoritiz: the yoonits ov mezhoorment ov elektrisiti, faur egzampl, shal be thoez adopted in aul kuntriz. The waits shal be thoez ov the Metrik sistem onli. Neu Inglish speling shal be yoozd in the siti until Fonetik Inglish is redi. 'The Mishuneri Dikshuneri and Gramar' shal be the standard."

Certainly much may be forgiven Mr. Arthur, so long as he leaves us the present units of electrical measurement, which have caused discussion and contention enough, without the added confusion of an entirely new and distinct set in Dunshalt.

Municipal Ownership and Operation of Street Railways.[1]

By H. H. Vreeland.

The discussion of this question, which, in the Unied States, is as old as the oldest franchise grants, has, in the last few years, owing to a singular intemperance of treatment, awakened such interest that the attention of the courts has been directed to it, after its treatment and discussion by orators, editors, legislators and university professors.

A singular feature of the voluminous literature the question has provoked is its single-sidedness. Those most vitally interested in the debate have not been heard. Everyone has spoken except the railway owner and manager and the passenger, who can in New York city now ride for five cents along 25 miles of road and through territory which 10 years ago would have cost him 25 cents and three hours of time. It is true the railroad man has had some skirmishing talk in the newspapers, but he has contributed nothing to the permanent literature of this subject. That, co-existent with the rise of this discussion, street railroading has had its greatest physicial development and improvement, may explain why the academical questions concerning the business have been so neglected. Whatever the cause, the fact remains that the advocates of municipal ownership and operation have had the field virtually to themselves for several years, and during that time have succeeded in circulating a number of falsehoods, which, unanswered, the people at large are justified in accepting as true. It is fair to suppose that during the years in which they have held undisputed control of public attention, the advocates of the doctrine have fully stated their case, and so it seems to me that at this time we are advantageously placed to view the whole of the claims made by them. In attempting to classify these claims, one is surprised, in reviewing the discussion, at their number and diversity. Here 'tis claimed that hours of labor of employes would be reduced; there, that wages would be increased; then, that in the hands of a set of men to be changed with every varying political wind, life would be made safer in cities; someone else explains how fares could be reduced and greater civility assured. The lack of unanimity is startling. On two points only are they all agreed, to wit: That something must be done to deprive the railroads of their property and rights; that something must be done to relieve the people from wrongs under which, demagogues and agitators complain, they suffer.

These two unanimous claims I will discuss later. I wish first to clear the question of what may be called an expired claim, which agitators imagine has still some vitality. When originally broached, municipal ownership was coupled with the idea of municipal operation, but this claim has been formally and publicly abandoned by the most advanced spirit in the so-called reform. In a discussion of this kind, it is bewildering to attempt to locate the responsible advocate, and when a sentiment has been developed by ungoverned discussion, one is at a loss whom to answer. For the purpose of a discussion of this kind, however, one may be justified in looking beyond self-appointed "Committees of Fifty," "Committees of One Hundred," "Co-operative Citizens," and all other so-called "bodies" to the "Association for the Public Control of Franchises," since it claims to have formulated the demand for municipal control and operation, and has stated the benefits to accrue from both. In its last circular, dated July 18, 1897, this association declares that

> According to the most conservative authorities, half the city's revenue could be derived from its street-car, gas and other franchises. In this event, taxes upon private and personal property would be cut in two.
>
> What is even more important to the mass of our citizens: Public control of transportation and illuminating will lead to a similar reduction in car fares and gas bills.

Let us pause for a moment and consider these claims, based, we must infer, on some knowledge of the subject. In the first place, half the city's revenue is to be derived from street-car and other franchises named. The city's annual revenue, according to the report of the comptroller for the year ending August 1, 1897, amounted to $104,449,390, derived as follows:

Taxes	$41,877,841.00
General fund	2,222,195.00
Appropriation account	241,393 00
Special and trust accounts	8,622,409.00
Loans	51,485 552 00
Total	$104,449,390.00

Unlimited as are the claims of the advocates of municipal ownership, I do not imagine they intend to insist that the city would not be compelled to borrow any more money after repurchasing of those franchises, and so, for the purpose of reasonable argument, let us subtract the item of the loans in the above table and state the total revenue at $52,693,838, which is the amount minus the item.

> According to the most conservative authorities, half the city's revenue could be derived from its street-car, gas and other franchises.

In other words, it could get $26,481,919, provided that the taxes still remained at $41,877,841. But, unfortunately, this amount is to be reduced, as "taxes upon private and personal property would be cut in two." How the city is to grow rich by a reduction of its revenue is explained in the second clause I have quoted from the circular. It is to be brought about by a "similar reduction in car fares and gas bills." An ordinary city, if its revenue from taxation was reduced 50 per cent., would have to increase the revenue derived from other sources in order to make both ends meet; but here it is proposed to perform the operation by reducing to one-half the only other available source of revenue. In other words, by reducing the revenue 50 per cent. taxes are to be cut in two. In view of the fact that, according to Edward E. Higgins, the recognized statistician on this subject, the entire net earnings (exclusive of interest for dividends) of street railways, gas and electric lighting properties in New York do not exceed $18,000,000 per annum, it is useless to pursue a discussion of these claims any further.

It is not to be expected that an advocate of municipal ownership and operation will be influenced by the statements of a railroad president on the subject. I take it, however, that both those who have a "professional" and those who have only a sentimental interest in this debate will accept as final the statements of such men as Dr. Albert G. Shaw, one of the professors of the Johns Hopkins University, and author of "Municipal Government in Great Britain" and "Municipal Government in Continental Europe;" Louis Windmueller, president of the Reform Club; J. Harsen Rhoades, Allen Ripley Foote, author of "The Law of Incorporated Companies Operated Under Municipal Franchises;" Frederick W. Wurster, mayor of Brooklyn; Charles A. Schieren, ex-mayor of the same city; John Joralemon, president of the Board of Aldermen of New York city, and a number of others equally distinguished, whom I will quote in support of the assertion that the idea of municipal operation has been abandoned as part of the doctrine.

If further authority than this is needed, it will be found in the quotation herein from a report made to the Legislature of New York by a special committee appointed for the purpose of investigating that subject of the alleged public demand for municipal ownership and control. This report is contained in two bulky volumes, accompanied by the testimony taken by the committee and published by the state as a public document in 1896. That committee not only failed to find that the demand for municipal ownership was supported by public sentiment, but reported directly against it in unequivocal language.

While the claim that municipalities should operate franchises may still have some pleaders, they are among the class of place-makers whose motives are so apparently selfish that honest public sentiment gives them no support, since it sees behind the plan the danger of multiplication of offices and enlarged opportunity for political patronage and corruption. If, then, we consider the subject with this original menace of municipal operation removed, the doctrine, in its bearing on railroad properties at least, is divested of some objections that were common alike to the conservative public and to railroad owners.

So far as the city of New York is concerned, all that is left of the original claim in favor of municipal ownership has been conceded in the normal development of the law, for that municipality now owns such franchises as have not already been given or sold to the highest bidder at public auction. To-

1. Read before the Street Railway Association of the State of New York, at Niagara Falls, September 15, 1897.

day, with us, no franchises can be legally given away; regulations are prescribed by statute under which they are sold in open market, after long notice, to anyone who offers the highest price for them. This highest price, by the way, is so fixed that it varies with the growth of the gross receipts earned from the franchise granted.

There remains, then, concerning the roads now in operation, the single question of municipalities purchasing back those franchises which they have already given and sold. Franchises that were given away in the early history of street railways in New York city were of little value at the time of granting, and the history of their development and the difficulties experienced in obtaining money to build and operate them would be interesting reading to those who insist on discussing them from the point of present value. The stock of some of the horse-car lines in New York city was given away in payment for hay, oats and bedding at 25 per cent. of its face value, and was only accepted at that rate for the reason that there was nothing else with which to pay. The heated advocates of municipal ownership and operation are ignorant of facts like these, and insist on discussing the original grants from the point of present value—a value largely imparted to them by the enterprise and good management of their owners. It is unfortunate, too, that the case of railroad franchises has been complicated in this discussion with that of other quasi-public grants, because the merits of our position are distinct. The benefits which street railway development have contributed to cities in a variety of ways is beyond calculation. Through its agency the death rate has been reduced by relieving the congestion of population in certain crowded areas, and it has increased the taxable value of real estate enormously. The careful consideration of this last economical feature of the question might well form the subject of a separate paper. I have not the time here to do more than suggest the subject as a topic for future discussion.

Let me, before proceeding to discuss the two claims before mentioned, quote you the authority on which I have based the assertion that the original demand for municipal operation has been abandoned. It will be seen from these quotations that the most advanced advocates of reforms of various kinds are far behind the irresponsible pleaders for confiscation and municipal management.

Dr. Albert G. Shaw, in a sworn statement made to a committee of the Legislature in November, 1895, in answer to a question, said:

I have never dreamed of advocating municipal ownership in the city of New York. I have never thought of it as a remedy.

Louis Windmueller, in May last, said:

I am opposed to the municipal ownership of public franchises. I think we have already too much paternalism, and that the business would be better conducted in the hands of private individuals or companies. We had a discussion about that some time ago in the Reform Club, and I was very much opposed to it, as we already have enough of political patronage as it is. I think the business is better conducted by private enterprise more honestly and economically than it would be under the municipal government's control.

At the same time, and in the same discussion, Robert B. Roosevelt said:

I am not in favor of government control of any more businesses.

Continuing the discussion, the Hon. Charles A. Schieren, ex-mayor of Brooklyn, said:

I have no opinion to express as to the advisability of a city owning these franchises and itself operating them. When I was in Glasgow, the mayor of that city said that he was of the opinion that the city should not own its street railways.

John Harsen Rhoades, on the same occasion, said:

I am opposed to public franchises being run by municipal ownership, for the reason that, under our republican form of government, there is already too much power exercised by the political parties of the day toward controlling the votes of those who are directly or indirectly in their service. In my judgment, to add to this power, with all the opportunities for corruption and bad management which have heretofore characterized so many of the municipal governments, would be a very dangerous thing.

The Hon. Frederick W. Wurster, the mayor of Brooklyn, discussing municipal ownership of gas works, took occasion to say:

I believe it advisable for the city to manufacture its own gas. Ownership of street railroads is something that should be carefully studied before it is adopted, from the fact that there are now in the employ of the different railroads of the city of Brooklyn 10,000, yes, I should say, nearly 15,000 men, and the question of so much patronage being given to any party is one that should be very carefully considered.

Speaking of the city railroads, John Joralemon, the president of the Board of Aldermen of New York city, in a voluntary contribution to the discussion, said:

I am of the opinion that private corporations can manage such large enterprises much more economically than would be practicable for a municipality.

John H. Inman, late rapid transit commissioner, testified under oath before the legislative committee, whose findings conclude this array of authorities, when asked his opinion on the subject of municipal ownership of railroads in the various cities of the state:

I do not favor it at all, except for perhaps a large enterprise like the proposed subway road in the city of New York; generally speaking, I do not favor municipal ownership of property of that character.

The late William Steinway, in this same proceeding, in answer to an identical question, said:

I would be entirely opposed to it. I think it would be a huge political machine, a refuge for old political hacks, no good for anything, and would make no money; the operation of these things should always be left to private enterprise, when the city's interest is properly protected.

C. E. Curtis, in the Yale Review for May, 1897, thoughtfully discussing the relations of street railways to the public in Great Britain, Canada and the United States, says:

For American cities to undertake this experiment (the ownership and operation of street railways) would involve such grave objections, through political abuses, as to far outweigh the possible advantages, especially as it is yet to be shown that the working of the tramways by English municipalities has in itself wrought substantial benefit to the citizens.

With this testimony before them, the committee of the Legislature reported back to that body:

We have attempted to give all classes an opportunity to be heard on the question of municipal ownership, and many have appeared before the committee and expressed their views, giving their reasons for or against the various municipalities of the state embarking in this business. But few have advocated the ownership and operation of railroads by the cities. The preponderance of testimony taken and the majority of opinion expressed before this committee are against the subject so commonly referred to as municipal ownership. It is obvious, under our present system of municipal government, the ownership and operation of railroads by the cities and municipalities would have a tendency to convert these enterprises into powerful political machines, the results of which would be detrimental to the public welfare. Under all the conditions and circumstances it would seem that the ownership and operation of street railways by the municipal authorities is quite impracticable at the present time. As an abstract proposition we believe that no government, national, state or municipal, should embark in a business that can be as well conducted by private enterprise. The reverse of this proposition carried out to a logical conclusion would put all business enterprises under governmental management and control, and leave to no citizen any hope, ambition or aspiration beyond that of seeking an official position that affords a meager existence.

If, in the face of the deliberate utterances and warnings of those who have officially investigated the merits of the question, it should still be determined that the municipalities of the state should own and operate the the street railway franchises, the two unanimous claims of the advocates of the doctrine, so far as New York city is concerned, will come up for discussion and consideration in this form:

How is the city to take possession of the property and rights now owned by private corporations?

What improvement can the city make to relieve the public from the "wrongs" which demagogues have invented?

An intelligent answer to the first question requires that reference should be made to the character of the property of a street railway corporation.

The property of such a corporation consists of its real estate, which includes land, buildings and track; its personal property, consisting of cars, horses and all movable chattels, and its franchise to construct, maintain and operate its road.

It is quite apparent that the franchise is the element which gives value to the corporate property. It is that upon which the earning power of the corporation depends, and it is that which gives value to the corporate stock.

The character and nature of a franchise as property has frequently been the subject of consideration by the courts.

It has been uniformly decided to be a contract and entitled to protection against legislation which would destroy it, or which by some alteration of the charter would impair its obligations. Corporations are entitled to have the clause of the Federal constitution liberally construed, so as to secure their franchises every immunity in such respects.

In the case of the People vs. O'Brien, which arose out of the legislation which annulled the charter of the Broadway Surface Railroad company, it was decided by the Court of Appeals that while the Legislature might annul and dissolve the corporate body, the franchise survived the dissolution of the corporation and was irrepealable and indestructible, and was property the value of which could not be taken from the creditors and stockholders of the corporation either through the action of municipal officers or by the Legislature. That the grant of the right to construct a railroad in the street was in perpetuity, and the title thereto was indefeasible, and that the track and the franchise to maintain and operate the road were inseparable. In another recent case before the Court of Appeals it was decided that the Legislature could not destroy or confiscate the property and franchise of a corporation, and that while such property was, like all other, held subject to the right of the state to appropriate it for necessary and reasonable public use, that could only be done upon just compensation being provided to be made therefor.

In the case of the Monongahela company vs. the United States, decided by the Supreme Court of the United States in 1893, there was an express direction in the act of Congress authorizing the acquisition of the plaintiff's property, that the franchise to collect tolls, which the corporation possessed on the Monongahela River, should not be estimated or considered by the commission appointed to appraise the value of the property. But the court held that the right to take tolls was as much a vested right of property as the ownership of tangible property, and that the national government, under the power to take property for public use, could not deprive the corporation of its right to take tolls without just compensation being made therefor.

The power of eminent domain, which is the reserved right of the state to take and appropriate private property for public use, can be exercised only under the constitutional limitation, that compensation must be made for all property taken, and when not made by the state it must be ascertained by a jury or by commissioners appointed by the court.

Assuming that ownership of street railways would be decided by the courts to be a municipal power, under the constitution the power of eminent domain can be delegated by the Legislature to municipalities, and it could be, through its exercise, in the absence of agreement with the corporation, that railroad property and franchises now in existence could be acquired by the cities of the state

Municipal ownership of street railways has never been the policy of this state, and before there can be such ownership the municipalities must be empowered, by appropriate legislation, to acquire and hold such property. When such enabling statutes are passed and the power of eminent domain delegated to the cities, street railroad property now in existence may be either purchased by agreement with the corporation owning and operating it, or may be taken after the value is ascertained by the method I have pointed out. In ascertaining and fixing that value, the most important element will be the value of the franchise to maintain and operate the road, and in fixing that, due regard must be had and due effect given to the future growth of the locality in which the roads are operated, and the life or term of existence of the corporation owning them, and the reasonable and just expectation which those who have invested money in such properties or its securities had in mind when so investing.

It is quite plain, therefore, that to acquire many of the existing roads in the state would impose upon the cities taking them a large burden of debt and taxation, which, in some instances, it is not improbable, would be entirely beyond the limit of indebtedness which the constitution imposes upon the municipal corporations of the state.

The answer to the second question, in view of the suggestion made in the authorities I have already quoted, will be obvious when I have stated what private ownership and consolidation under the Metropolitan street railway system in the city of New York have done for the traveling public in that city.

Nowhere in the debate on this subject have I been able to find, even in the statements of the most heated advocate of municipal ownership and control, any denial of the fact that the centralizing under single management of the various railroads that make up the Metropolitan street railway system has improved the public comfort and convenience. The extent and nature of the benefits which this centralizing has achieved is best shown by the statistics. The following table shows the expansion of its transfer system for the last 10 years:

Year.*	Miles of Track.	Paying Passengers. Total Number.	Transfer Passengers. Total Number.	Transfer Passengers. Prop. to Paying.	Average Fare. (Cents)
1896–97	190	177,338,677	56,929,611	32%	3.78
1895–96	172	145,965,251	28,450,996	19	4.18
1894–95	140	109,686,472	9,671,697	9	4.59
1893–94	131	107,036,524	5,306,654	5	4.76
1892–93	80	63,011,785	3,203,832	5	4.76
1891–92	61	45,239,670	2,645,800	6	4.72
1890–91	37	39,971,929	2,766,080	7	4.68
1889–90	36	39,571,464	3,523,239	6	4.70
1888–89	36	37,386,809	2,206,866	6	4.72
1887–88	36	37,318,730	1,996,871	5	4.75

*Years ending June 30th, except 1887–88 and 1888–89, which ended September 30th.

From this table it will be noticed that in the first seven years about one passenger out of 15 or 20 received a transfer; in the year 1894-95, one out of every 11 passengers received a transfer; in 1895-96, one out of every five; and in 1896-97 about one out of every three.

The phenomenal development by the company of this great privilege speaks for itself. By means of it, the general fare during the whole day has been reduced to 3.78 cents, and during the crowded rush hours of morning and evening, when the working people are going to and coming from their work, the average rate of fare is only 2.5 cents. This transfer system, like the lighting of cars and various other improvements, was done without legislative compulsion and in accordance with the settled policy of the company to increase public safety and cheapen transit.

While voluntarily developing this transfer system, the company has also made large contributions annually to the funds of the city and state. A resolution was recently passed by the Board of Aldermen of New York city, demanding that the comptroller furnish the board with a statement of the amount of taxes paid by the various street railroads in the city of New York, and the comptroller furnished it with the following table, showing the amounts paid, during the year 1896, by the Metropolitan Street Railway company and the Metropolitan Traction company:

CITY TAXES.

Percentage of receipts	$ 43,101.93
Fixed rental	150,000 00
Car licenses	40,280.00
Personal tax	39,114.27
Tax on real estate	112,607.30
Track taxes	54,489.75

STATE TAXES.

Percentage of earnings	$ 90,000.00
On capital stock of Street Railway company	20,000.00
On capital stock of Traction company	42,000.00
Total	$591,593.25

In this statement no account was taken of the contributions of the company, amounting to over $100,000, in the shape of repaving and maintaining pavements.

The time is ripe, I think, for a clear understanding

of this question of municipal ownership, and if one could be assured that those who advocate it understood the situation, there would, to my mind, be no cause for heated discussion. The trouble with the discussion thus far has been, that most of those who have taken part in it have been either ignorant of the truth, or have wilfully ignored facts that were within easy reach. When people are informed that railroad franchises are no longer given away in New York city, but that they are sold by the municipality, after a long advertisement, to the highest bidder, for a percentage of the gross earnings, which secures to the municipality a participation in the yearly increase of the business developed by the company along the line in question, and by means that bring to it the contributing travel collected along and on about 200 miles of road elsewhere in the city, it seems to me that loose talk about franchise grabbing will not find attentive listeners.

The trouble is that the question is discussed, not in the light of existing conditions, but with continual reference to methods and practices long since obsolete. It would not be a greater anachronism to discuss transcontinental travel from a stage-coach point of view than to refer to the present system of traffic in cities as most of the advocates of municipal ownership insist upon considering it. No later than 15 years ago the only revenue the city received from these franchises was in the shape of car licenses; whereas, to-day, as I have shown in the figures given above, a single corporation contributes over a half million dollars to the public treasury.

I have nowhere seen any definite figures presented by the advocates of municipal ownership and control, so far as it relates to street railway properties, and I think, when these figures are arrayed, the gentlemen who advocate ownership and control will hesitate. Roundly stated, the street railway properties in the city of New York, and they are only a small portion of the franchises proposed to be taken, can be purchased for about $295,000,000. I hardly think that, in the present state of the public's mind, there is any likelihood that the city of New York will take upon itself by purchase so great a burden, especially when it is coupled with the danger of expensive management and political opportunity.

The Influence of Accurate Measurements upon Economic Operation.[1]

By C. D. Haskins.

In no branch of commerce, save perhaps in some of the industries dependent upon the generation of electrical energy, is it considered sufficient to know only what raw material is used and what revenue is received.

Until very recently, however, there has been no satisfactory method of actually determining how much electrical energy has been produce during any given period.

Many generating stations in the early days followed a system of frequent readings of ammeters and voltmeters, basing their assumptions as to actual output on the product of coincident readings multiplied, of course, by the time factor, thus obtaining an approximation of the kilowatt-hours output per day and therefore the approximate cost of generation per kilowatt-hour.

Many, however, abandoned these frequent readings of instruments, feeling that the approximations of true output measurement were too unreliable to be of real value, because of the constant fluctuation of load between readings.

The conditions just described are in reality those of yesterday rather than to-day, and they existed only up to that time when it became possible to obtain output meters of sufficient capacity to measure in an accurate and proper manner the true output.

Such meters as those to which I refer are now readily obtainable and are being rapidly adopted, not only by street railway companies, but by lighting companies also.

Electrical engineering skill has responded to the needs of the industries to which it is tributary, and standard designs now exist up to capacities as high as 8,000 amperes, while special instruments have been designed large enough for 16,000 amperes.

These total output meters are accurate to a high degree, not only upon steady and normal loads, but upon rapidly fluctuating loads as well, giving a true energy account of all energy output through them on loads ranging from five to six per cent. of their rated capacity up to about 15 per cent. above their rated capacity, the reliability of the record being unaffected with the rapidity of fluctuation of current between these points.

It is doubtless needless for me to emphasize the real economic value of the reliable data which can be obtained by the use of these total output meters.

Knowing the efficiency which is to be expected from the generator, engine and boiler equipments, it is a simple matter to determine just how much coal and water should have been expended for the run of any given day to generate the indicated kilowatt-hours output.

Thus it not only becomes possible to determine just what it is costing to generate a kilowatt-hour, but it also becomes possible to check the inefficiency of the equipment and to locate trivial faults which might otherwise have escaped notice.

For example, should the indicated output fall 10 per cent. below what ought reasonably to be expected from the known input of coal and water, an effort would at once be made to determine where the trouble lay, whether in uneven firing of the boilers, ill-set valves on the engines, or some minor fault in the generator.

In no other way known to me can this positive means of check upon the generating system be maintained than by the use of total output meters.

Important as is the measurement of the total station output, there is yet another application of positive measurements, which, while it has long been appreciated by many, has not been applied in practice at all up to the present time, simply because the necessary meter was not available. I refer to the measurement of the energy used daily to operate each car.

Every street railway management realizes that a quite large proportion of the total energy generated is wasted by the careless and improper use of the controller and the brake, and where the old rheostat method of control is used the opportunity for waste on the part of the motorman is yet greater.

Almost every street railway superintendent makes a different estimate of the percentage of power wasted upon the system under his charge, for there can be no positive knowledge upon the subject, nor can the conditions be regarded as at all stable.

An average, drawn from the opinions which have been expresed to me, would, however, indicate that no less than 20 per cent. of the total energy generated is wasted by improper manipulation of the handles upon the part of the motorman, this improper manipulation being due to some extent to ignorance, but more generally to carelessness.

A meter has now been designed which will, I believe, change all of these wasteful conditions. This meter is intended for permanent installation upon the car, and its indications show accurately the consumption of energy in kilowatt-hours for any desired time.

Grave difficulties surrounded the designing of a satisfactory meter for this purpose, and the perfecting of the device has only been accomplished by sustained effort extending over a long period. It was necessary not only that the meter should be accurate under the extremely unfavorable conditions of heavy vibration and shock, to which it has been exposed, but also that its construction should be of such a character as to endure these rough conditions for long periods without damage to the mechanism and without the impairment of accuracy.

Such a meter as that which I have described is now obtainable, and has been successfully operated in actual service over an extremely rough piece of track for many months.

With a street-car meter permanently installed on every car the street railway management at once has the same means of checking the motorman as is provided by the cash register for checking the conductor.

Assuming that the energy wasted is actually 20 per cent. of the total, as I believe it to be, it is, I think, fair to expect a saving of at least half the present waste, or 10 per cent. of the whole amount of the energy generated, as a result of the knowledge on the part of the motorman that the management has absolute means of ascertaining how much power he uses per run or per passenger or per mile. For, under this system, he cannot fail to realize that the management has in its possession adequate and reliable data upon which to base promotion or encouragemnt, rprimand or discharge.

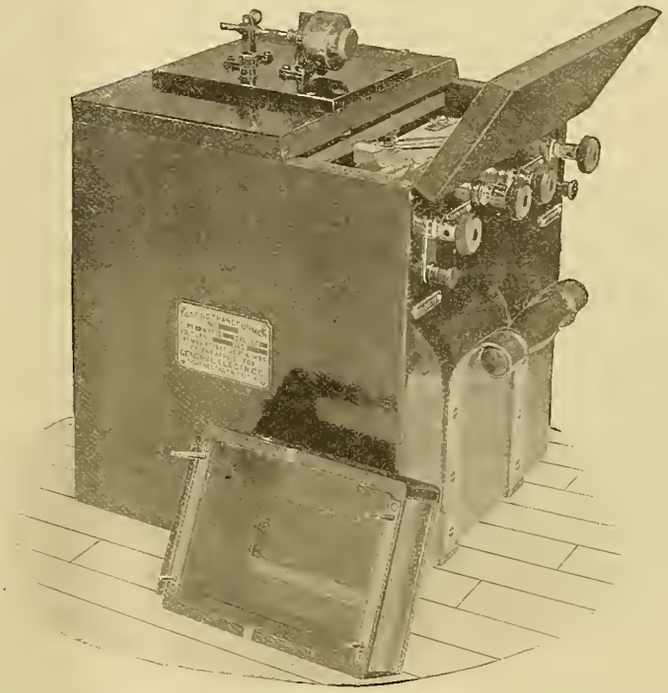
Many steam railroads have long made a practice of offering annual prizes to the engine crew doing the most work with the least coal and water, and I anticipate that a similar system of reward may be found advantageous and profitable in street railway practice.

Cutting down the waste of energy 50 per cent. means saving 10 per cent. of the total output, and it therefore means to the street railway management either the saving of 10 per cent. of the coal and water which is being used to-day, or the ability to operate 10 per cent. more cars with the same central station capacity. In whichever way the matter may be viewed—whether in the light of a saving of raw material, or an increase in service without increase in expense at the station—the economy accomplished is very great, and you will all, I am sure, agree with me when I venture to assert that the influence of accurate measurement upon economic operation is of the first importance, provided proper use is made of the data thus obtained.

1. Read before the State Association of Street Railways of New York, September 15, 1897.

High Potential Testing Transformer.

It is a well-known fact that electrical apparatus may show high insulation resistance when tested in the usual manner at low voltages, and yet may be easily damaged by the application of a few thousand volts potential. A thin film of air will show almost infinite resistance when measured with a galvanometer, but it offers practically no resistance to the path of a high-tension current. For this reason, when determining the security of apparatus, such as the secondary of a lighting transformer, against high-potential charges from the primary circuit, it becomes necessary to test by the direct application of high potential across the insulations to be measured. For this purpose the General Electric company has developed the 10,000 volt high-potential testing transformer shown by the cut. This consists of a small transformer wound on a rectangular core, similar in construction to that of the "Type H." The low-tension circuit is wound on one branch of the core, and on the other branch the primary coils are placed. There are four primary coils, each wound and insulated independently, the four coils being assembled on a sleeve of heavy insulating material. After assembling, each transformer is tested to a maximum strain of 35,000 volts between the high and low-potential windings, thus insuring safety from accident. By means of a porcelain series multiple connection board the apparatus can be used on either 52 or 104 volt circuits. The transformer itself is immersed in oil.



HIGH POTENTIAL TESTING TRANSFORMER.

On the top of the apparatus is a box with a glass window, enclosing a micrometer spark-gap arranged as a shunt across the high-potential terminals. This box or cover carries four long contact studs, fitting into sockets in the transformer box. The lifting of this cover for the purpose of adjusting the spark-gap entirely disconnects the spark-gap from the high-potential circuit. On one side of the transformer case are six terminals, two for the main circuit, two for the adjusting rheostat, in series with the low-potential circuit, and two small terminals providing connections for a voltmeter permanently across the low-potential circuit of the transformer. The transformer case is mahogany; the trimmings are of nickeled brass and polished hard rubber. The case is provided with two handles for transportation, also with a

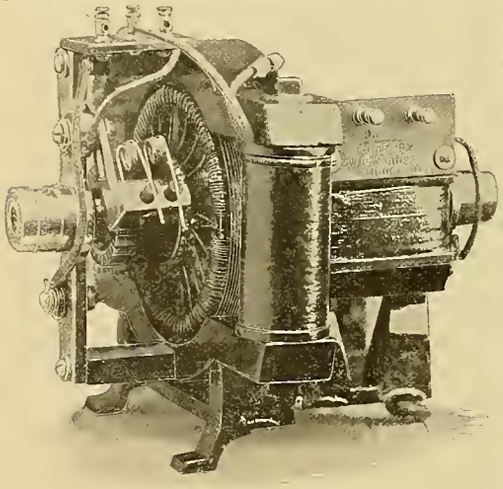
stop-cock for drawing off the oil when necessary. Provision is made for readily polishing and re-adjusting the points of the spark-gap.

When using the apparatus the spark-gap is first set to discharge at the limit of voltage desired, readily done either by the use of a calibration curve or by a voltmeter on the low-potential circuit, the ratio of the transformer being known. Having adjusted the spark-gap, the apparatus under test is connected to the high-potential terminals on the spark-gap base and the potential again brought up to the amount desired and held as long as necessary. The apparatus under test is thus connected in multiple with the spark-gap, and the accidental application of higher voltage than was intended will merely result in the formation of an arc across the spark-gap, short-circuiting the apparatus under test and protecting it from damage. The transformer is designed to run on either 50 or 125 cycle circuits and to deliver up to 10,000 volts at a normal current of .05 ampere in the high-potential circuit. This can, however, be exceeded for shorter periods.

The rheostat used to control the voltage on the low-potential side may be of any convenient type. A small rheostat of portable form for this purpose has also been developed by the General Electric company. This consists of a vertical tube and stand with a fixed contact plate at the bottom and another plate attached to a sliding rod, the rheostat being filled with water to which a small quantity of salt or soda has been added.

The Warner Telephone Generator.

The accompanying cut illustrates something new in the way of a generator to supply current for operating subscribers' bells from telephone exchanges. The motor which drives the generator is mounted on the same shaft and base. The manufacturer states that exhaustive tests have proven this little machine equal to any and all requirements of a desirable telephone generator. Chief among its many desirable features is the saving of power over that required by an ordinary high-speed motor belted to a generator. It takes about one-half ampere at 110 volts to operate it and runs at a very slow speed, being almost noiseless. It is portable, compact, convenient, and, it is claimed, requires less than half the power used to drive the regular high-speed motor and gerator; no belt to slip and break, no high-speed motor to heat and rattle, no special room needed for its installment, and can be placed in the operator's room, on a desk, shelf or any convenient place. It occupies a space less than 12 inches square, has large self-oiling bearings, runs perfectly cool and requires little attention. The design is handsome, making it an ornament to the office or wherever placed. The motor can be wound for all continuous current circuits, of any voltage, but is regularly wound for 110, 220, 500 volts. It is arranged for two different speeds. The generator can be wound for any resistance, but is regularly wound for 30,000 ohms. The machine has a capacity suitable for 1,200 'phones, and is guaranteed to ring six 'phones continuously.



THE WARNER TELEPHONE GENERATOR.

This generator is manufactured by W. F. Warner of Muncie, Ind.

International Patent Relations.

A Washington dispatch states that Commissioner Butterworth and Assistant Commissioner Greeley of the Patent Office are engaged in putting in shape amendments to be offered to the treaty existing among the leading nations of the world "for the protection of industrial property." A meeting of the representatives of these nations has been called to convene in Brussels next December, and it is the purpose of this country to secure, if possible, certain modifications of the present agreement.

The convention was entered upon for the purpose of protecting patents, trademarks and other similar interests.

Article 2 of the treaty is one which, it is said, this country will seek to have changed. As the article stands it provides that the citizens of each of the contracting states shall enjoy in all the other states the same advantages that are given to the citizens of those states.

It has been found that this provision works a hardship upon our patentees taking out patents abroad, entirely out of proportion to the tax upon foreigners taking out patents in this country. The intention now is to ask for a reciprocal arrangement which will provide that while American patents may be issued to citizens of other countries on the same conditions in other respects as they are issued to American citizens, our rates to them shall be made equal to theirs to us. They are now many times cheaper.

There will also be an effort to restrict the articles which are patentable in this country, so that the subject of another country cannot patent an article in the United States upon which he cannot secure a patent in his own country.

An amendment will also be suggested on behalf of this country to Article 4, so as to define more clearly the right of priority and put inventors of this country on the same footing as those of other countries where patents are granted, without the preliminary examinations which our laws require.

Advantages of Up-to-date Street Car Service—Why the Rate of Fare Should Not Be Reduced.[1]

By C. L. Rossiter.

One has only to recall the wretched transportation facilities of horse-car days to appreciate the advantages of an up-to-date street railway. We remember the small, dimly-lighted horse cars, so cold in winter that straw was placed in them to keep the feet warm, and so poorly lighted that it was impossible to read in them. Insufficient horse power frequently made it necessary for passengers to get out and assist the horses on the steep grades. To-day over 80 per cent. of the street railways in this country are operated by electricity, and millions of new capital have been expended in constructing the necessary new tracks, cars, electric equipment and expensive power houses, so that to ride in one of the modern cars of an electric railway to-day is a positive pleasure, and thousands of dollars of the income now received by the roads comes from this pleasure riding.

The electric street railway to-day is essential to every city, not less so than its department of sewers, water and street lighting, and, in fact, the railroad in nearly every case is the pioneer in all the improvements and building up of the city. The railroad corporation are very frequently looked upon as being antagonistic to the city's interests, and both the public and the city are oftentimes inclined to impose unjust burdens and hardships upon the roads; when, in fact, the capital to construct the railroads is furnished by banks, trust companies and organizations having in their trust the savings of the people.

It is only a few years since the western part of our country was almost unknown, its wonderful fertility and resources of no profit to mankind. It required only the railroads to make possible the populating of it, building up its vast area and bringing its enormous yields of grain to the eastern market, thus adding untold wealth to our nation. In the same way the up-to-date electric railway opens up the suburbs of our cities and makes it possible for those of moderate means to find pleasant and healthful homes, obtainable in no other way, and enriching the city by adding to its taxable value.

The purchase of a piece of farm land for building purposes in the suburbs of any of our cities is followed immediately by a request upon the local railway to extend its line, and without such extensions it will be found that the city itself will be very slow to make expenditures for the improvement of the streets and sewers, water mains, etc., and next to impossible to get the gas and other companies to extend. In support of this statement some figures in regard to Boston are very instructive, showing, as they do, in the case of Brookline, a suburb of Boston, that in the 30 years from 1855 to 1885 the increase in value was from five and one-half millions to sixteen millions, while in the next five years, years with the introduction of the street railway, the value increased to thirty millions. Another case that will illustrate this has occurred in Brooklyn. During the year 1896 one of the roads constructed an extension some three miles in length, through an entirely new territory, where the streets for blocks had not been cut through and no improvements whatever made to the adjoining property. To-day, less than a year after, many houses have been built (nearly all of them being occupied as soon as completed), on the line of this street and adjacent side streets. If it had not been for the railroad extension not one of these houses would have been built, and it can be readily seen that it is not the railroad company which will reap the first benefits, but the city, which will have increased its assessment roll not less than $3,000,000 in the present year, and the opportunity given to hundreds of individuals of finding comfortable homes. If the city and the public treat the railroad companies justly and fairly, there will be no trouble caused by the policy that the companies pursue, as nothing pays better to the owners of the railroad property or to the city itself than to have an up-to-date railway in its cars, equipment, tracks and facilities, and the roads can be trusted as they continue to be prosperous to give the greater part of every nickel that is taken in to the public in the shape of good wages to their employes, thus securing competent and reliable men, and also expending, as it can afford to do so, the necessary money for extensions as required, and for new cars and equipment properly maintained, and the companies will continue this policy so long as the public show appreciation of it by patronizing the cars. On the other hand, if the earnings of the road are not sufficient to properly and well maintain the property the spectacle of old cars and equipment and negligent employes will be seen, and, while this means loss to those who have invested, it is no less a direct loss to the city and the public which has such a railroad. To secure the needed funds for extensions and improvements of our electric roads there must be a perfect understanding between the city and the owners of these properties. If the city places unnecessary burdens and taxes on the roads that cannot be met, then those who are called upon to furnish the capital will refuse to do so and the city will be the loser ten-fold over what it could possibly gain in any other way.

I believe the street surface railway to be as necessary to a city as its street, sewer, water and gas systems, and if the railways to-day can maintain friendly relations with the city's representatives and give to them and to the public full information as to the financial and physical condition of the properties, a much better understanding will be had and the final result will be to secure the good-will of those on whom success of the railroads depend. An up-to-date street railway service pays the company itself, particularly if it has a competitor who is not up to date, and it pays the city and the public in the immediate benefits they receive, in clean, attractive cars, good service, and freedom from accidents, and it pays the employes of such a company to be identified with it and to assist in bringing such a result about, as well as in good wages promptly paid.

In regard to the matter of fares and why they should not be reduced, I want to say at the outset they have been reduced, and to-day the street railways of this country are carrying passengers a longer distance and at cheaper fares than in any other country in the world. The distances in the 10 largest cities in this country where the public is carried for a single fare of five cents range from 9.9 miles to 18 miles; this latter in Brooklyn. In horse-car days a ride of five miles for a single fare was a long one and the average was below this. The railways in Glasgow, Berlin, and some other foreign cities are frequently referred to as furnishing lower rates of fare. This is not so. On the contrary, they are not only much higher, but they have many disadvantages which would not be tolerated in this country. The average and usual rate in England is two cents for the first mile and one cent for each mile thereafter, and this works injury to the laborer and artisan classes. In this country the average rate is from one-fourth to one-half cent per mile, and in many cases less than one-third cent per mile. Abroad five representative cities average 11,099 population per mile of track. Seven of the largest cities in this country average 2,127 population per mile of track. This means that the laboring classes and artisans abroad are compelled, on account of the high rates of fare to the suburbs, to live in the crowded quarters of the city, to the menace of their health, and this overcrowding and density of population is causing much concern to the cities; while the railroads in this country, with five times the tracks and facilities to the same population, give to those who desire it the opportunity of finding comfortable homes in the suburbs, where their families can be properly brought up. In the matter of wages of conductors and drivers, in England they receive from 85 cents to $1.12 per day of 10 hours. In this country the conductors and motormen receive from $1.75 to $2.25 per day of 10 hours. Very many trips are run on all our roads for the accommodation of the public on which the revenue taken in does not equal the wages of the conductors and motormen, and the average street railway to-day with the luxurious and comfortable electric car, well lighted and well heated in winter, gives the cheapest transportation in the world.

It has been said that it would be an ideal condition to have the street railways all confined to some lonely field in the remote country, where they could be run on time, never crowded, and quite unobjectionable, but quite useless also; but as crowded thoroughfares are unavoidable in a large city, and means of transit indispensable, the problem is, how best to accomplish it to the benefit of all concerned. Complaint is too often made without cause and without reason. The fact is that most of the roads are giving better service to the public than they can afford, the trouble being that the people expect too much for five cents.

1. New York State Street Railway association, Niagara Falls, New York, September 15, 1897.

The explosion of an incandescent electric lamp in Bismarck, N. D., completely destroyed the eyesight of Mrs. R. D. Hoskins, wife of the clerk of the Supreme Court.

Street Car Wheels—Should They Be Made Heavier?[1]

By F. D. Russell.

It seems to me this subject might be better handled by some practical street railway man, the user of the wheels, than by the maker, for the one knows from actual experience what is needed, while the other can only get his knowledge second-hand, as it were, from observation, and by keeping in touch with what is going on. However, to see what can be done with the subject by the maker, suppose we first glance at the motors, beginning with the earliest, their weight and power, and then at the character of the service, and see what is now required of wheels.

Mr. Sprague's Richmond motor, of the summer of 1888, which I understand is the same as Edison No. 6, had 15 nominal horse power, and could work up to about 23, under favorable conditions. Its weight was about 1,700 pounds, and it required a 3¼ inch axle. The F 30, another double reduction motor of 1888, was rated at 20 horse power, could develop 30, and weighed 2,200 pounds. The S R G of 1891, and the W P 30 and 50 of 1892, as also the G E 800 and G E 1,000, which brings us to the spring of 1896, together with the Westinghouse motors of corresponding period, are so well known to all of you that I will not go into detail regarding them further than to say that by the spring of 1896 we arrived at 35 to 50 horse power motors nominal capacity, and weight of 2,100 pounds to 2,400 pounds, using 3¾ inch or four-inch axles. I understand the Westinghouse company has made a special 62½ horse power motor for Pittsburg, using a four-inch axles, and that there is a G E 51 rated at 80 horse power, competent to work up to 120, and weighing nearly 4,000 pounds. This uses a 4¼ inch axle. Of course, there are larger motors, but this is about the limit at the present time for street-car service. I confine myself for purposes of illustration to these two lines of motors, and no neglect is intended toward any other makes.

Of course, motor wheels have been undergoing during the last nine years a somewhat similar development to that of the motors, trucks and cars, and may be said to have kept pace with what has been required of them. Our first 30 inch motor wheel weighed about 250 pounds or 260 pounds, and our first 33 inch was a 300 pound wheel, and, I may add, this is a good pattern yet, for moderate sized cars at not over 15 or 18 miles. Next we came to 280 pounds for the 30 inch, and 325 pounds for the 33 inch, and then, which was about four years ago, to 300 pounds and 350 pounds respectively and remained at that for a couple of years or so, with the exception, of course, of special lots from time to time. About a year and a half ago we added about 20 pounds to wheels for interurban service, which brought us to 370 pounds or 380 pounds. We also brought out a 400 pound wheel, having eight spokes or arms instead of the usual number of seven, for fast, long runs, also snow plow and snow sweeper and sprinkler service. These are all 33 inch wheels. On 30 inch we now run about 325 pounds, sometimes to 335 pounds and 350 pounds, but 325 pounds is probably heavy enough for a 30 inch wheel.

I do not wish to be understood that mere weight is in any sense desirable. The lighter the wheel, in fact, the lighter the whole equipment within limits, the better it is for the roadbed. The service is bad enough for the tracks as it is, without adding any more weight than is absolutely necessary. A comparison of the weights of the motors will show that the increase has been mainly in capacity. Take, for example, two Westinghouse motors, viz., the 15 horse power of 1890, and the 50 horse power of 1896. These both weighed 2,400 pounds. And so it has been with us to an extent. There is a great deal in the manufacture of a wheel besides the mere question of weight. The question of the pattern, the careful apportionment of all parts to obviate strains in cooling, the mixture and treatment of the iron, as well as the annealing of the wheels, not to mention any number of minor things, which have to be watched carefully, all these must be combined to produce a thoroughly reliable wheel. To sum up briefly, and taking the 33 inch wheel for a standard, our conclusion is that 380 pounds to 400 pounds on 2¼ inch and 2½ inch tread is not any too much for the present service.

There are two factors which try the very withers of cast-iron wheels. One is the twist or tortional strain as the motor drives the wheel, and the other is the heating of the periphery of the wheel from the friction generated by high speed, or continued application of the brakes. This latter, I firmly believe, is the hardest part of the service required of a motor wheel, because it tends to expand the rim, and set up a severe strain where the arms, which remain cool, unite with the rim. All our patterns are designed to resist this strain.

Now a few words on the subject of standards—axle standards, I mean, for the wheels, in tread and flange, are gradually approaching as near to a standard as the varying conditions of service will admit. We lately purchased about 1,000 bars of steel for axles, and it was nothing short of a Chinese puzzle to make up a list which would properly cover our needs. Taking the trucks in order of length of axle, we have:

Taylor axle, 6 feet 3 inches long.
Peckham axle, 6 feet 4⅝ inches long, and 6 feet 6⅜ inches long.
Brill axle, 6 feet 5 inches long.
McGuire axle, 6 feet 5 inches long, and 6 feet 6 inches long.
Bemis and Baltimore axle, 6 feet 5¼ inches long.
Diamond axle, 6 feet 5½ inches long.

I have not at hand the lengths of the DuPont or Dorner & Dutton, or any other axles not mentioned in the above list, but you can depend upon it, they are different.

The foregoing lengths are on standard gauge and usual tread, which means not exceeding 2½ inches. All, I believe, are subject to variation where wheels have treads wider than 2¾ inches, and, of course, for wider or narrower than standard gauge.

My idea in speaking of these varying lengths of axles, is to suggest whether you cannot get together and establish a standard axle, and by amicable arrangement with the various truck makers, bring about the adoption of a standard length of axle, a standard journal, a standard brass and a standard box. The master car builders of the steam railroads long ago took exactly such action, and it is nothing new which I suggest. They have a uniform standard. Their axle is six feet 11¼ inches long, and the journals and boxes and brasses are interchangeable the country over. If they could establish such a standard, why cannot street railways arrange for the same? Instead of interfering with the interests of any truck maker, it seems to me it would benefit, and it certainly would simplify matters enormously for everybody concerned.

1. New York State Street Railway association, Niagara Falls, N. Y., September 15, 1897.

Low Joints—How to Prevent Them.[1]

By C. Loomis Allen.

Nearly every street railway company has a stretch of poor track which for good reasons it is trying to use for a term of years or until such a time as it is possible to rebuild with what is now called "permanent construction," and the greatest of the trackman's troubles in keeping this track in a condition for the operation of cars is the joint. In the majority of cases it the joints that were placed on the rail at the time of the construction of this track remain in use the bolts will become loosened and at a great many joints shear off. The supporting ties may be tamped solid, yet the joint will hold its proper place for only a short time.

In Syracuse, last fall, during our reconstruction, we had a street 4,500 feet long, in which were double tracks. The structure was a 47 pound stringer rail upon five by seven inch pine stringers, the ties supporting the stringers every five feet. It was our aim to save as much of this structure as possible and yet have a track structure in the street which would survive a period of five years' traffic. At the end of that time it is hoped that all the sewers, water, gas and conduits will be in the street, so that permanent construction can be built without being ruined during the process of construction of these underground structures.

The paving was removed and the stringer rails consigned to the scrap heap, the stringers and ties lowered 2½ inches below the original grade. Ties were introduced between those under the stringers so that the spacing under the stringers was 2½ feet between centers. To the stringers were spiked the Johnson company's 66½ pound girder rail, which had been removed from track by reason of failure at joint. This rail had been laid on chairs and had become so worn at the joints that it was doubtful whether it could be used; but, aside from the deflected ends, the rail was in good condition and not worn out. The ends of a great many of these rails were tested for deflection previous to laying and in many cases 3-16 inch deflection was found. What effect traffic would have upon the ends of the rail after placing upon them the Weber joint was a result that was awaited with much interest. This joint was purchased with the idea of benefiting the rails, bringing them up to grade and in proper line. The rails were laid with broken joints with rail ends butted tight. No trouble was encountered in placing the joint, and the track structure was completed and paved in. It was our intention at the time of construction to operate on the track a day or two previous to replacing the pavement, and then to tighten the bolts once more firmly. The conditions of traffic would not allow this and the structure was paved in without this second tightening.

At first the cars which were operated upon this track pounded considerably at every joint. As the construction of this track was completed just before the final freeze-up last fall, the pounding was made more prominent by reason of the frost holding the track structure firmly.

In the spring, after the frost had left the ground, the rails were examined, and although no metal was restored to the head of the rail the ends of the rail had been brought up to grade and line. The bolts of some of these joints had become loosened, so that paving blocks were removed at the joint and the bolts thoroughly tightened. This track is not as good a track as our standard nine-inch construction, but we have saved from the scrap heap rails, that without the use of these joints, could not have been used as re-laying rails. This construction, we believe, will do the work expected of it, i. e., the carrying of traffic for a period of five years.

During the past four years girder rails nine inches in height, with brace plates and with joint plates of varying dimensions as to thickness and length, have been considered standard material for permanent construction, but the joint is still the weakest portion of the track structure.

Three things that are important in the solution of the joint question are as follows:

First—Materials used in track construction.

Second—Manner of supporting the rails.

Third—The location of the joints in relation to each other.

In the purchase of track material for nine-inch construction, if the rails are all that are considered, and the selection of a suitable joint for the rail is passed upon lightly, one would naturally buy that which would give to him track material at the lowest cost per foot of single track, i. e., the joint would be the cheapest joint purchasable. The other appurtenances aside from the rail would receive like treatment. But if, on the other hand, a good track structure throughout is desired, with a minimum cost of maintenance after the track construction has been turned over for operation, due consideration will be given to all track appurtenances before final decision is made to purchase cheap material. Good material throughout is necessary to good construction, and without it permanent construction cannot be had. The best material purchasable to-day will be poor enough after 10 years of operation under electric traction.

Considering that good materials are economical, we will now turn our attention to the support of the rails. The support of the rails along the entire length is just as important as for the rail to be well supported at the joints. The greater the number of lineal inches of tie-bearing supporting the rails when the ties are well ballasted and tamped, the longer the life of the track structure. To give good support to the rails, ties should be placed as close together as it is possible to do so and yet give room to properly tamp with the tamping bars the ballast supporting the ties.

The manner of fastening the rails to the ties should be carefully considered. Spikes that will give good holding power and not split or cut the ties so as to injure them should be selected. The joints in the rails upon either side of the track should not be opposite each other.

Rail ends of the same section very frequently show, upon being calipered, that there is a difference in their height, and when two ends like this are united by the joint a pound or blow will result at this joint, causing a weakness upon that rail of the track. If another joint is laid immediately opposite upon the same ties supporting the poor joint, no matter with what care or in what condition the joint when laid may be, this pound or blow will have its effect upon the good joint, and it will not be long before two weak spots will appear on the track where, if the joints had not been laid opposite each other, there would have been but one; on the other hand, if the joints be laid broken the pounding is transferred by the axle of the car, not to the weakest spot on the opposite rail, i. e., the joint, but to the solid portion of the rail. The cost of maintaining to proper grade and line track laid with broken joints is not so great as track having joints laid opposite, as when once repairs are needed, the latter will require attention a greater number of times. In the construction of permanent track to-day, street railroads have the joint question to face only half as many times as they did three years ago. Sixty foot rails have cut the joint question in two.

We are laying in Syracuse the following construction at the joints, and from it have had no trouble: The joints are laid broken with rails butted tight. Corrugated joint plates, 9-16 inch thick and 36 inches in length are bolted tight by means of 12 one-inch bolts, the nuts of which are held in place by the Young gravity nut lock. The ties at the joint are laid to form what is known as the three tie joint; the center tie supports the rail ends equally, and the other ties are laid so that the ends of the joint plates are supported upon the center of the ties, thus giving three ties supporting the rail underneath the joint plate. The spacing under the rails, aside from the joint, is 1.93 feet between centers of ties, giving 32 ties to every 60 feet of track. The ties used are southern yellow pine, six inches by eight inches by eight feet, and they are supported by eight inches of broken stone ballast.

The question of low joints cannot be solved by simply considering the joint alone, nor by considering everything else and omitting the joint. The whole track structure must be considered. The subgrade upon which the ballast is placed must be made perfectly firm. The ballast must be of good thickness to give proper subdrainage and thoroughly rolled to give firm support. The ties should be the best obtainable, and, as stated before, the closer spaced the better the track structure. The steel rails and their appurtenances used should be the best material that money can buy, and when this track material is properly assembled the question of low joints should not arise for some time.

1. New York State Street Railway association, Niagara Falls, N. Y., September 15, 1897.

N. Bink has been granted a franchise for electric lighting at Chilton, Wis.

Virginia Telephone Notes.

[From the Richmond, Va., correspondent of the Western Electrician.]

The record in the case of the city of Richmond against the Southern Bell Telephone company has been sent from the United States Circuit Court to the United States Circuit Court of Appeals. The case will be argued the second week of the November term, possibly November 10th or 11th. An opinion will probably be rendered by February. The opinion is expressed that the ruling of Judge Goff will be somewhat modified if not reversed by the higher court.

The Select Council of Norfolk has confirmed the action of the Common Council in directing the city attorney to take measures to prevent the Bell Telephone company from doing local business in the city

It is stated that the Bell Telephone people are to make another effort to get a foothold in Hampton, and it is also asserted that if the present company does not give better service than it is now giving, the former company will carry its point.

While fixing a wire on a cross-tree of a telephone line in Portsmouth a few days ago, Charles Yeager, a young man employed by the Southern Bell Telephone company, touched an electric light wire with his foot. The shock caused him to lose his balance and he fell across the electric light wire, breaking it and carrying it down with him. He struck the street head foremost, fracturing his skull, and dying almost instantly. A horse car was passing under the wire at the time and two horses were caught in it as it fell. They were killed almost instantly. The driver was severely shocked.

The improved switchboards have been put in place in the central offices of the Staunton Mutual Telephone company. Hereafter the office will be open all night and the service greatly improved.

CORRESPONDENCE.

New York Notes.

New York, September 21.—The hearings of the Supreme Court's commission of inquiry into the rapid transit scheme have been resumed. One witness, Arthur Crowell, a civil engineer, was of the opinion that Mr. Parsons' borings were not sufficiently accurate or comprehensive to guarantee a close estimate of the cost of the road.

The stockholders of the Metropolitan Traction company at the special meeting held last week authorized the winding up of that company and the exchange of the stock for that of the Metropolitan Street Railway company. There was represented at the meeting over $24,000,000 of the stock out of a total of $30,000,000. The vote in favor of the proposed dissolution of the Traction company and the distribution of its assets was unanimous. An agreement was approved between the Traction company and the Metropolitan Street Railway company by which the assets of the Traction company other than the $30,000,000 of street railway stock in its treasury were assigned to the street railway company and capitalized in the sum of $6,000,000. These assets covered about two-thirds of the capital stock of the Second Avenue Railroad company, more than two-thirds of the capital stock of the Central Crosstown Railroad company, 600 bonds of the Metropolitan Crosstown Railroad company and Broadway Surface Railroad company, about $1,700,000 in cash; part of the stock of the Central Park, North and East River Railroad company, also of the Forty-second Street and Grand Street Ferry Railroad company, and $270,000 worth of improved city real estate—property and cash equal to about $6,000,000. The directors recommended and the stockholders approved the accepting from the Street Railway company of a five per cent. obligation in the way of a debenture, interest upon which should begin to run after the earning capacity of the property had received the benefit of the expenditures now being made. The Metropolitan Street Railway company has on hand, with the money assigned by the settlement of the Traction company, in the neighborhood of $7,000,000 cash, for which bonds have been issued, which money is being expended in the improvements of the property. The improved facilities being created will begin to earn in December probably, but the large development cannot be made for a considerable time thereafter, and the stockholders of the Traction company were asked to forego interest upon the certificates of indebtedness until next summer, when the new improvements will have largely increased the earnings. This was unanimously voted by the stockholders. Each stockholder will receive in lieu of his Traction stock an equal amount of Street Railway stock and 20 per cent. in these certificates.

A libel for $3,500 damages was filed in the United States District Court on Thursday last by William H. H. Curtis, master of John Jacob Astor's yacht Nourmahal, against the steamboat Mary Powell, which sank an electric launch belonging to the yacht in the North River on September 6th. Captain Curtis says that the sinking of the launch was due to the improper and negligent manner in which the Mary Powell was navigated.

General Collis, commissioner of public works, having refused to grant the application for opening Amsterdam avenue to construct the proposed trolley conduit line, the Forty-second street, Manhattanville and St. Nicholas Avenue Railway company has asked for a mandamus to compel the commissioner to issue the desired permit. General Collis objects to four tracks on the street, and suggests that the Third Avenue and Metropolitan companies use one set of tracks in common. He says: "My engineers inform me that the construction of four tracks on this avenue, with underground conduits, would not only imperil existing city property, but would render ready access to our many underground pipes almost impossible, but at all events risky and expensive. There are upon this street already six water mains, each four feet in diameter (similar to those I am now laying in Fifth avenue) upon which the entire population of the city depends for the safe conduct of a sufficient water supply. In addition there are two electric subway conduits, one 20 inch and one 12 inch water main, six gas mains eight and ten inches in diameter, one 30 inch gas main and one 20 inch gaspipe. In fact, this avenue is the great artery through which flows most which is vital to the health and comfort of the citizens, and it should be protected by my department whenever threatened." The corporation counsel has suggested that the commissioner shall make an application to the State Board of Railroad Commissioners setting forth the difficulties which may result from the proposed change, and asking that the case be reopened and reheard. The corporation counsel adds: "Even if the railroad commissioners should not deem it wise to rescind the consent already given by them, they may surround such consent with such restrictions, conditions and modifications as will obviate or lessen the difficulties suggested by you. If I can render you any assistance in pursuing the course I have suggested, I shall be glad to do so." General Collis promptly accepted the suggestion. He said that he was already preparing affidavits to show that the existence of four tracks in Amsterdam avenue would be a menace to life, limb and property, and also to demonstrate that the use of two tracks is feasible and less expensive than the use of four. Commissioner Collis said that he would write to the railroad commissioners at once. In the meantime the issue of a mandamus is to be opposed by the city.

M. S.

Northwestern Notations.

Minneapolis, September 20.—The stock subscriptions for the proposed Twin City Electric company at Grand Rapids, Wis., are coming in fairly well, and the projectors expect to have the plant installed by next season at the latest. The company is co-operative.

Allan Thompkins of Minot, N. D., will establish an electric light plant at Devil's Lake, N. D., at once.

The Superior Rapid Transit company of Superior, Wis., contemplates changing its tracks to standard gauge, in order that connection may be had with Duluth without change of cars. Large cars, such as are in use between Minneapolis and St. Paul, are to be used.

There will be a general change in the officers of the Gas and Electric Light company of Fargo, N. D. Among the new officers will be ex-Sheriff O. G. Barnes.

The Electric Light association of Waupaca, Wis., has made a proposition to build an electric railway to the Chain of Lakes, if the city will enter into a 10 year contract for street lighting. It is suspected this is a shrewd move on the part of the company to secure itself against a municipal lighting plant, as the city is about to buy the waterworks plant, and could easily operate an electric lighting plant in connection.

Citizens of Menominee, Mich., have petitioned for the extension of the street railway line on Broadway.

The Manawa Railway company of Council Bluffs, Ia., proposes to build an electric railway to connect with the East Omaha line.

H. C. Higgins, president of the Marinette, Wis., street railway, and his brother, Thos. Higgins of Neenah, Wis., have bought the electric railway between Peru and La Salle, Ill., and propose to expend $25,000 in improvements.

Jerry Taylor, manager of the Rocky Mountain Telegraph company of Butte, Mont., has disappeared, leaving a shortage in his accounts, the extent of which is unknown. He had been "playing the races." He has been located at Minot, N. D.

The municipal electric lighting plant in Negaunee, Mich., has been completed and put in operation.

The sheriff is in possession of the waterworks plant at Maplewood Springs, owned by the Tacoma, Wash., Gas and Electric Light company, which was levied on to satisfy a judgment.

An electric light plant is being discussed for Tyndall, S. D.

An electric lighting plant will probably be put in at the state university in Bozeman, Mont., as soon as the buildings are completed.

The council of Mankato, Minn., has finally accepted the bid of the Mankato Gas and Electric company for electric street lighting.

The City Council of Casselton, N. D., voted to establish an electric lighting plant, the cost not to exceed $6,000. The city has cash enough in the treasury to pay for it.

General Hughes of Bismarck, N. D., has made a proposition to establish an electric light plant in Fargo, N. D.

The contract between the Star Electric company and the city of Dubuque, Ia., has been extended for 10 years.

The electric light plant in the waterworks pumping station at Madison, Wis., has been completed and put in operation. It cost about $600.

The Northern Lumber company of Cloquet, Minn., is putting in an electric lighting plant for the yards and mills.

The Valley City, N. D., Council has decided to make a lower price for electric lighting than was at first proposed.

The street railway company and the Citizens' Traction company of Oshkosh, Wis., are getting together on a price for the sale of the former's system to the latter. The street railway company has reduced its price to $37,000 for its system and the electric company offers $31,000. Citizens are raising funds to meet the difference, and it is expected that the sale will be made shortly.

George B. Ellison has resigned from the electric company of Albert Lea, Minn., to accept a position on the road with the Western Electric company of Chicago.

The Merrill Railway and Lighting company has contracted to furnish the city of Merrill, Wis., with 60 arc lights of 1,200 candle power for $3,300 per year.

J. E. Tomlinson of Centerville, S. D., contemplates erecting an electric light plant in Woonsocket, S. D.

It is announced that the project to extend the electric car line from Clear Lake, Ia., to Fertile, Ia., is now an assured fact.

Jared How of St. Paul, representing eastern bondholders in the electric street railway company of St. Cloud, Minn., has been looking over the system to ascertain what improvements are necessary. It is likely that in addition to improvements to the rolling stock and roadbed a new power house will be built.

The District Court at Ottumwa, Ia., has compelled the Western Union Telegraph company to produce certain telegrams in court. The company was inclined to refuse, but finally acceded to the requirements of the court.

The council of Cedar Rapids, Ia., recently ordered some additional street lights, at a price below the contract price for the present lights. In reply the Cedar Rapids Electric Light and Power company says it cannot afford to furnish light for less than the contract price, and offers to sell the plant to the city.

Judge Crofoot and Stenographer Granger of Aberdeen, S. D., are about to apply for a patent for an electrical selecting instrument which they have jointly invented, which provides a means whereby central offices can select any one of a series of switches or electrical devices, all on a single wire, and operate it without operating or acting upon the others.

When the Northwestern Guarantee Loan company of Minneapolis failed in 1893 it carried down with it the Gallatin Light, Power and Railway company of Bozeman, Mont., which was a creation of L. F. Menage, the head of the Guarantee Loan company. Joseph Kountz has acted as receiver since that time. The financial difficulties of the institution have been cleared up and a cash offer has been made by Henry Elling, Mr. Kountz and George L. Ramsey for the property, which has been accepted.

D. M. Benton has made a proposition to install an electric lighting plant at Whitehall, Wis.

It is claimed that a right of way has been secured between Rockford and Rockton for the Rockford, Beloit and Janesville electric line, and that the project will be carried out. Rockton people claim that the power house is to be located there.

J. H. Marshall has bought the electric light plant at Roseau, Minn.

F. W. Springer has been appointed instructor in electrical engineering at the University of Minnesota at Minneapolis.

C. L. Jensen and others have applied for a franchise for a street railway at Hot Springs, S. D., and offer to use electric power after the city attains 5,000 population and animal power until that time.

The work of laying rails for the new electric railway at Menasha, Wis., has been begun.

An electrical inspector has found a great deal of defective electric wiring in Negaunee, Mich.

The council of Des Moines, Ia., has passed an ordiance reducing rates for electric lighting. The electric companies will doubtless contest the matter in the courts.

C.

PERSONAL.

George S. Hegeman, vice-president of the Hart & Hegeman Manufacturing company of Hartford, Conn., died recently in Detroit. He was on his way to the Pacific Coast, and, stopping over in Detroit, expired, after a three days' illness. He was 40 years of age and unmarried.

According to a New York newspaper, Lord Kelvin passed through that city last Saturday on his way to Southampton, Long Island, where he will spend a few days with John Bottomley, an old acquaintance. After his visit at Southampton Lord Kelvin will again proceed to Canada on an important mission for the British government, which

will detain him for a week or 10 days. He will then sail for England, after a short stay at Lenox, Mass., with Lady Kelvin, as the guest of Mr. and Mrs. Westinghouse of Pittsburg.

In Atlantic City, N. J., on September 20th, Patent Commissioner Butterworth was the victim of a street attack by two robbers, one of whom was identified as a notorious criminal. Major Butterworth made a desperate struggle, and finally, with the assistance of passers-by, overpowered the ruffians.

Frederick P. Fish of Boston, leading counsel of the American Bell Telephone company, has been suffering from a severe attack of typhoid fever in a New York hospital since the latter part of July. Mr. Fish's illness explains the delay in the Berliner litigation. It will be remembered that testimony in the cases under the Berliner patent, now pending in Boston, was to have been completed September 1st. The time has now been extended.

Mr. and Mrs. Henry A. Pevear of Lynn, Mass., celebrated their golden wedding on Thursday of last week. There were music and flowers, troops of friends and many handsome presents. Mr. Pevear was president of the Thomson-Houston Electric company, and is one of the most prominent citizens of Lynn, where he was for many years engaged in the leather trade. His son, John B Peavear, is the assistant manager of the General Electric company at Cincinnati.

Charles A. White of Malden, Mass., very well known to the electrical men of the country, died at his home on September 16th, Bright's disease being the cause of death. Mr. White was for some time engaged in the lumber business, but of late years was associated with Charles E. Bibber in the electrical supply trade in Boston. He was married, and Mrs. White and two children survive him. Mr. White was a pleasant, genial man of fine presence, and he was popular in electrical circles. He also had a taste for politics, and in January last was elected president of the Malden Common Council. His death is widely regretted.

ELECTRIC LIGHTING.

Sealed proposals will be received at the office of the clerk of the city of Charlotte, Michigan, until noon on October 2d, for lighting that city by electric lights for the term of three years, under the following propositions: First, 15 arc lights to run all night and 26 or more arc lights to run until midnight every night in the year; second, 41 or more arc lights to run to midnight every dark night during the year; third, 41 or more arc lights to run until midnight every night and all night every dark night during the year. All arc lights are to be 2,000 candle power. M. B. Warren is the city clerk.

ELECTRIC RAILWAYS.

The Railroad Gazette says: "A report states that the contract has been let for building the Galveston and Houston electric railroad, which is to run between the two cities mentioned in the title. Work is to be begun by October 15th and completed by April 1, 1898." Such a road would be about 55 miles long.

The Chicago General Railway company, formerly known as the McGann concern, announces that it is about to extend its Kedzie avenue line, which now runs from Twenty-second street to Thirty-first street south to Sixty-third street, where connection will be made with the Chicago City railway. On the north it will extend the Kedzie avenue line to Ogden avenue, where connection with Yerkes' West Side line will be had and beyond that point. This will give the Chicago General a Kedzie avenue line between seven and eight miles long.

The annual reports of the railroad commissioners of New York and Massachusetts show that of 19 companies operating less than 250,000 car-miles, four are obtaining power at a cost of less than two cents per car-mile, six between two and three cents, five between three and four cents, one between four and five cents and three at more than five cents. Of the five companies operating over 5,000,000 car-miles per year, one obtains the power at less than one cent per car-mile, three between one and two cents and one between two and three cents. Other similar figures are also given between these limits. The Brooklyn Heights company has the cheapest power, 0.86 per car-mile, followed by the Binghamton with 0.94. The cost of power for Massachusetts roads includes repairs and depreciation of the station plant, which is not the case with the New York roads.

TELEGRAPH.

In a report to the State Department Consul Germain, at Zurich, Switzerland, says that the total length of the world's telegraph system has now reached 4,908,823 miles, exclusive of 181,440 miles of submarine cable. This mileage is apportioned as follows: America, 2,516,548; Europe, 1,764,790; Asia, 310,685; Australia, 217,479; Africa, 99,419 miles.

The Society of the United States Military Telegraph Corps, in session at Nashville, elected the following-named officers for the ensuing year: W. B. Wilson, Holmesburg, Pa., president; E. Rosewater, Omaha, vice-president; J. E. Pettit, Chicago, secretary and treasurer. The convention adjourned to meet next year in Omaha.

TELEPHONE.

W. J. Kurtz, president and manager of the National Telephone company of Indianapolis, and P. A. McDonald propose to organize a new telephone exchange company in Anderson, Ind. It is said that the franchise has been secured.

TECHNICAL SCHOOLS.

Prof. Olin H. Landreth, professor of engineering in Union College, Schenectady, N. Y., has issued a special circular descriptive of the improvements in the engineering school of that institution. The students of this school have special privileges in the works of the General Electric company.

ELECTRICAL SECURITIES.

The New Orleans Traction company reports gross earnings for July of $104,062, a decrease of $12,044 as compared with the same month of last year, and net $23,710, a decrease of $22,746.

A decrease of $116,139 in the receipts of the Staten Island Rapid Transit company is shown in the annual report just issued. The company's operating expenses were cut down $24,218, but the charges were increased nearly $7,000. From a surplus of $26,445 in 1896 the company has dropped to a deficit of $72,457.

A Western Union director is reported as saying that earnings of the company as shown by test offices are now upon a larger scale than for a long time past, the improvement being uniform all over the company's system. A rough estimate of actual receipts is made by doubling figures recorded at test offices. The ratio of this increase in the last three weeks, if continued throughout the year, would produce earnings equal to half the amount that is called for to pay the yearly dividend. In other words, the company is now earning at the rate of about 7.12 per cent.

During the six months ended August 31st the Chicago Metropolitan "L" road earned net $129,048.50, or five per cent. interest on $5,161,920 of bonds, a trifle more than one-third the present outstanding issue. Considering that the months in question cover a period of low earnings, it may be taken with reason that the Metropolitan, as now situated, is in a position to earn five per cent. on one-half of the $15,000,000 bonds it has outstanding. If access to the loop, which the road will soon have, is to help the property in any such measure as anticipated, then the road ought to be able to earn sufficient to pay five per cent. interest on $10,000,000 of bonds. If it proves its ability to do this, the reorganization committee will probably scale the bonds one-third, distributing among the bondholders, non-cumulative preferred stock or income bonds of a par value equal to the amount scaled off their bonds.

MISCELLANEOUS.

The National Electrolytic company, capitalized at $200,000, has been incorporated, to manufacture chlorate of potassium at Niagara Falls. The company has contracted for 1,000 horse power with the Niagara Falls Power company, and by next spring hopes to have its product on the market. The directors of the company are James A. Roberts, Edward Michaed, Henry Koons and Tracy C. Becker of Buffalo, Charles W. Hackett of Utica, William T. Gibbs and Stanislaus P. Franchot of Buckingham, Quebec, Canada. The new industry is one of the fruits of the Dingley tariff, and the directors have elected the following-named officers: President, Edward Michael; secretary, Henry Koons; treasurer, Tracy C. Becker. Franchot & Gibbs have been in the business of making chlorate of potash in Buckingham, Quebec, and their process has been a success. The salt from which chlorate of potash is made comes from Stassfurt, Germany, in bags weighing 224 pounds. It is known to the trade as muriate of potash, the correct name being chloride of potash. The production of chlorate of potash by electrolysis will have a tendency, it is said, to revolutionize the trade.

TRADE NEWS.

Announcement is made by the D. A. Kusel Telephone Manufacturing company of St. Louis that, owing to the growth of its business, it will be compelled to enlarge its capacity (for the second time in 18 months), and that, therefore, it will remove to 1123 Pine street on or before October 1st. In the new location the company will have double the space formerly occupied. It is noted that the orders are principally for supplying equipment for long lines.

A daily newspaper announces that the Westinghouse Electric and Manufacturing company has received from its European company notice of the award to it by the Metropolitan Electrical Supply company of the contract for a large electric lighting plant to be installed in London. The apparatus will be of the multiphase type, involving the use of the Tesla patents, which are owned in England by the Westinghouse company. It is understood that the contract amounts to between $350,000 and $400,000.

The Massachusetts Chemical company of Boston makes most elaborate tests to insure the high-resistance properties of its insulating compounds. "Five cents' worth of poor insulation," it says, "will disable a thousand-dollar machine," and so, as the company claims, every lot of crude material used is exhaustively tested. Mr. Farrington, the treasurer of the company, states that in his opinion the Massachusetts Chemical company is making 75 per cent. of the insulating compounds (paints and varnishes) that are used in the world. He attributes this solely to the quality of the materials, obtained only by indefatigable investigation of what he calls one of the most intricate problems ever presented. He says that the Chemical company's foreign salesman has just returned from Europe with flattering reports of the prosperity of the electrical industries there and of large sales of the products of the company.

BUSINESS.

Business is very good with the Card Electric company of Mansfield, O., and were it not for lack of space a long list of recent orders for dynamos and motors could be enumerated here. These orders came from the East, the South and the West, and in addition the company is having more inquiries than it ever had.

The Murray Iron Works company of Burlington, Iowa, is building one of its well-known Sioux Corliss engines for the new Armour packing house at Omaha. This engine is to be of the cross-compound condensing type, of 300 horse power, and its design and construction will embody all the late improvements in high-grade engines.

Taber & Mayer of Boston, Mass., report that they are rushed in order to keep up with their orders for telephone apparatus, and are now considering extending their capacity in order to meet the demand. This firm has taken a prominent position in the trade in the manufacture of telephone switchboards, transmitters, receivers and various telephone supplies.

The Hope Appliance company of Providence, R. I., has recently perfected a line of knife switches which will be offered to the trade soon. These switches will be manufactured in the usual excellent style of this company, and "no shortage of material necessary to carry the current as agreed for it" will be a guarantee that will go with every switch that is sold. This concern is rapidly increasing facilities to take care of a large business this fall.

Although the New England Butt company of Providence, R. I., has done a good business during the depressed times, it has prepared to meet a changed condition of trade by the purchase of large amounts of raw material. This precaution was taken none too soon, as a decided improvement is already seen in orders for the line of apparatus which this concern manufactures. The braiding machines are known as standard among the manufacturers of insulated wire.

The Stromberg-Carlson Telephone Manufacturing company is enjoying a steadily increasing trade in its public exchange apparatus. It is not only continually adding many old exchanges to its list of regular customers, but is constantly equipping newly established exchanges with complete systems. Among the company's most recent orders for complete exchange and toll-line systems are those for Sheldon, Ill., Huntsville, Texas, Freeport, Fla., and Hume, Ill.

The Electric Appliance company has just completed the distribution of its latest edition of catalogue known as General Catalogue No. 12. Every mail brings a large number of complimentary letters from customers and the trade in general from all parts of the country. It is very evident that the style in which this catalogue has been issued is the one that is the most satisfactory to the trade, and the Electric Appliance company will undoubtedly reap the benefits that naturally come from the exercise of the best judgment in matters of this kind.

The Kneeland Reflector company of 24 Travers street, Boston, has recently offered a new price-list of its reflector shades which very materially changes the former quotations made by this concern, and it will be well for purchasers of this class of goods to write to the Kneeland company about it. It will be remembered that this company is the original patentee and manufacturer of the ground glass bottom reflector shade known as the McCreary shade, and as its contract with Mr. McCreary has

expired, it states that it is now prepared to furnish the trade at factory prices.

A. G. Roth, one of the active members of the firm of Roth Brothers, manufacturers of electrical machinery, Chicago, has just returned from an enjoyable vacation, and informed a representative of the Western Electrician that he is again "ready to receive orders" for Roth apparatus. It is hinted that Mr. Roth became an expert bowler while away from Chicago.

Assistant General Manager M. L. Livingston of the Standard Thermometer and Electric company of Peabody, Mass., has recently returned from a short trip to various cities in the East with some large orders for the Upton Midget enclosed arc lamps. He states that this lamp is destined to be a quick seller, having the advantage of burning 150 hours and being made for high and low tension street railway and power circuits. It can be placed in almost any room because it is only 22 inches long, and has the least possible mechanism, while the claim that it is the cheapest to buy and maintain is of the very strongest character.

George W. Patterson, until recently with S. F. B. Morse & Co., Chicago, has just been appointed Chicago and western representative for the Gordon-Burnham primary battery and the Fiberite company's Medbery switches and overhead railway material, with office at 1114 Marquette building. Mr. Patterson is well known to the electrical fraternity through his past connection as "the right-hand man in Morse's office," and also by his very ingenious electrical Indian clubs (first famous at the Trocadero in 1893), with which he often entertains friends and the public. Mr. Patterson is a "hustler," and with two such agencies, backed by his pleasing address and energy, he will, without doubt, make a success as a man "in for himself."

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued September 14, 1897.

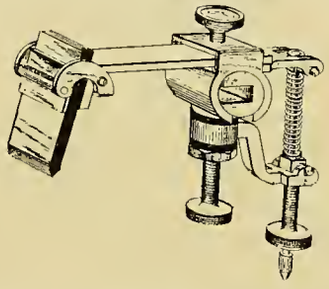
589,830. Secondary Battery. Henry W. Headland, London, England. Application filed February 11, 1896.

A metallic grid-like support for the active material consists essentially of a series of superposed open frames of polygonal form interconnected at their exterior and interior angles by connecting bars or posts.

589,832. Electrical Signaling Device for Use on Pneumatic Conveyer Tubes. George W. Hook, London, England. Application filed February 1, 1897.

A trigger arm is provided with a convex side extending into the conveyer tube and pivoted within an air-tight chamber outside the conveyer tube, and a cam on the axis of the trigger arm; a contact device is adapted to be operated by the cam as the trigger arm swings on its pivot.

589,838. Coil for Electrical Machines and Method of Making Same. Benjamin G. Lamme, Pittsburg, Pa. Application filed April 17, 1897.



NO. 589,904.

The method described of manufacturing bar windings for armatures of electrical machines consists in forming a single flat bar of approximately uniform lateral dimensions into a loop, the arms of which are approximately parallel and lie in the same plane, then bending the respective arms in opposite directions about an axis which is parallel to the long portions of the arms and which passes through the end of the loop.

589,839. Armature for Electrical Generators and Motors. Benjamin G. Lamme, Pittsburg, Pa. Application filed July 2, 1897.

An armature is described comprising a core provided with slots and a winding located in the slots, the winding comprising an inner long bar and outer short bar in each slot, and end connecters bolted or riveted to the projecting ends of the bars.

589,842. Method of Manufacturing Electrodes for Secondary Batteries. Henry Leitner, Niederschönhausen, Germany. Application filed January 23, 1896.

The method consists in finely powdering and intimately mixing about ninety-five per cent. oxide of lead with about five per cent. carbon, turning that mixture into a pulp by aid of a suitable medium, forming the pulp into a flat or curved plate by distributing it upon a sheet of pierced lead, or upon a piece of lead network, letting the pulp become hard, reducing it to porous lead by exposing the plate to the action of an electric current and subjecting the plate to a high pressure.

589,845. Coil for Electrical Machines. John P. Mallett, Pittsburg, Pa. Application filed February 15, 1897.

This coil comprises straight parallel sides of unequal length, the opposing faces of which lie in converging planes and ends, each of which consists of a portion adjacent to the long side and approximately perpendicular thereto, and a longitudinally inclined portion joining the perpendicular end portion with the short side.

589,865. Switch for Electric Circuits. Herbert B. Shallenberger, Rochester, Pa. Application filed May 26, 1897.

A switch for electric circuits comprising a base having two pairs of jaw terminals and a pair of block terminals, a pair of blades connected at one end by an insulating head and having their other ends bent to form bow springs, and bolts or screws for pivotally fastening the spring ends to the block terminals.

589,891. Elevator Controller. Maxwell W. Day, Schenectady, N. Y. Application filed June 12, 1897.

Contacts are provided for connecting the motor with the source of supply, and means for disconnecting the motor from the source and connecting a resistance across the mains; also means for shunting the armature by a portion of the resistance.

589,893. Automatic Switch for Surface Contact Railways. Edward M. Hewlett, Schenectady, N. Y. Application filed January 25, 1897.

A controlling device for an electric car provided with motors, a storage battery and a resistance has contacts and connections adapted to include the battery at starting in series with the motors and one part of the resistance, and in multiple with another part of the resistance, and to cut it out as the speed of the motors is increased.

589,894. Surface Contact Railway. Edward M. Hewlett, Schenectady, N. Y. Application filed May 27, 1897.

The automatic switch is actuated by a contact in the roadway to open the battery circuit, with a switch acting to reverse the leads between the motors and battery and the contact shoes.

589,897. Bell. Samuel Jevons and William Collins, Birmingham, England. Application filed October 28, 1896. Patented in England July 21, 1896.

A single hammer is arranged between two bells and common to both, the single armature attached to the hammer, a pair of magnets arranged to act on the common armature, the contact pillars, one on each side of the armature, the contact springs carried by the armature, a circuit and push-button for each magnet and contact pillar, and a double push-button independent of the two first mentioned and adapted to be located at any desired distance therefrom, with circuit connections for closing both circuits to energize both magnets and sound both bells from the common hammer.

589,904. Dynamo Brush Holder. John A. Marsh, St. Louis, Mo. Application filed January 9, 1897.

An improved dynamo brush-holder having a casting provided with a slot adapted to be fitted over a quadrant bar of a machine, a casting movably secured to the casting held to the quadrant bar, a bar adjustably secured to the movable casting, a clamp placed upon the end of the bar, the clamp carrying a brush, the movable casting regulated by a spring, the spring connecting both castings.

589,938. Electrical Cigar Lighter. Timothy C. Dobbins, Telluride, Colo. Application filed May 11, 1897.

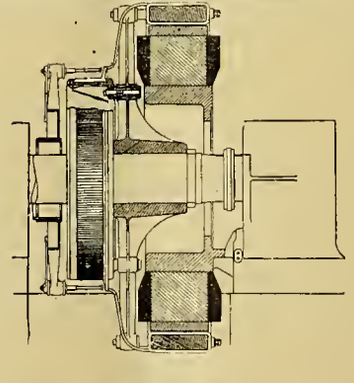
A block having rows of insulated metallic pegs, the pegs in the alternate rows being electrically connected and adapted to be oppositely polarized, with a separate metallic igniting device constructed to be drawn across the surface of the pegs to create a series of short circuits, and thereby cause an ignition of the material on the igniting device.

589,996. Electric Arc Lamp. Thomas E. Adams, Cleveland, Ohio. Application filed July 28, 1896.

In an arc lamp there is the combination with a magnet having salient poles of like polarity and a consequent pole of the other polarity, of an armature pivotally supported between its ends by the consequent pole within the path of the lines of force, the armature being constructed and adapted to be vibrated by the action of the salient poles.

590,000. Mounting for Commutators of Dynamo-electric Machines. Erasmus Caemmerer, Chicago, Ill. Application filed May 13, 1897.

The dynamo-electric machine, with the commutator and the commutator frame supporting the commutator but electrically insulated therefrom, and an insulating mounting interposed between the commutator frame and the supporting part of the dynamo-electric machine.



NO. 590,000.

590,021. Brake Mechanism for Power-driven Vehicles. John R. Price, Brooklyn, N. Y., Application filed May 12, 1897.

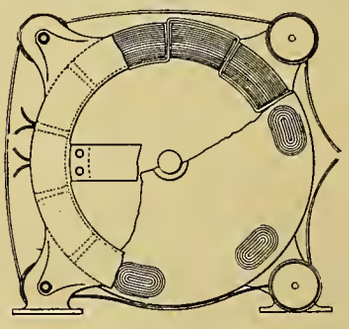
This electrically propelled vehicle employs two electric motors mounted thereon and an electro-magnetic brake device operatively connected with the brake lever.

590,098. Alternating Current Generator. Henry Fairbanks, St. Johnsbury, Vt. Application filed March 6, 1897.

A continuously magnetized field magnet having its poles facing each other, each pole divided into two or more equal pole divisions alternately right and left-hand wound with generating coils, separate inductor masses reaching nearly across between the poles, and each substantially of the size of the presenting end of one of the pole divisions, and a non-magnetic carrier arranged in one position to present the inductors fairly to all the right-hand wound pole divisions, directing the magnetic flux through them, and in the next position to present these inductors to all the left-hand wound divisions, directing this flux in the same way through them, whereby an alternating current is induced in the generating coils.

590,136. Telephone Exchange System. William W. Dean, St. Louis, Mo. Application filed November 3, 1896.

Two telephone lines are employed, each provided with a switch at the subscriber's station, and at the central office switching devices for uniting the lines, in combination with a signaling generator adapted to be closed to the called subscriber's line when the lines are united, an electro-magnetic circuit-changing device provided with two windings or helices, one winding being connected with the generator circuit and the other being connected in a local circuit containing two openings and a source of current, one of the openings being closed when the lines are connected together, the switch of the called subscriber when operated being adapted to reduce the resistance of the circuit containing the signaling generator to increase the current traversing the coil connected with the generator to operate the electro-magnetic circuit-changing device, to close the other opening of the local circuit, and immediately thereafter to open the connection between the generator and the coil or winding of the electro-magnetic circuit-changing device connected therewith.



NO. 590,098.

590,137. Telephone System. William W. Dean, St. Louis, Mo. Application filed September 28, 1896. Renewed August 2, 1897.

One claim is for the combination of line wires leading from a central office to subscribers' stations, with calling apparatus at the subscribers' stations, a calling generator, an electro-magnet adapted to include the generator in circuit with the subscribers' calling apparatus, means operated by the called subscribers' apparatus for removing the generator, and apparatus at the central office for exclusively controlling the operation of the electro-magnet, whereby its operation by sub-station apparatus is prevented and false signals obviated.

590,151. Secondary Battery. Gilbert Hart, Detroit, Mich. Application filed January 14, 1897.

An electrode for this storage battery consists of two similar sheets of metallic lead, each sheet having half cells formed by walls integral with the sheet, the side walls converging toward the latter from the open top of the trough to its bottom, the two plates being united with the half cells registering adjacent series of the cells being separated by plane vertical portions of the united sheets, which are united when the two plates are brought together.

590,185. Telephone Exchange System. William W. Dean, St. Louis, Mo. Application filed July 2, 1897.

The essential features of the system include the combination with a telephone line having a switch and a signal bell at the subscriber's station, of a circuit independent of the telephone line, an electro-magnetic circuit-controlling device connected in the circuit, means governed by the switch for changing the electrical condition of the circuit, whereby the operative condition of the electro-magnetic circuit-controlling device may be altered, switching apparatus at the central office for uniting and disconnecting telephone lines, a calling generator, a calling switch adapted to be operated by the circuit-controlling device to include the generator in circuit with the signal bell at the station when the condition of the independent circuit is normal or unchanged by the operation of the switch at the subscriber's station, the switching apparatus being adapted to associate the calling switch with the telephone line upon being manipulated to connect subscribers for conversation, and a switch in the independent circuit also provided for the purpose of controlling the same.

590,186. Telephone System. William W. Dean, St. Louis, Mo. Application filed July 12, 1897.

Telephone lines extend from subscribers' stations to an exchange, each subscriber's station being provided with a signal bell, with switching apparatus at the exchange for uniting subscribers' lines for conversation, a calling generator, a calling switch adapted upon being actuated to include the generator in circuit with the bell at the called subscriber's station, a detent adapted to engage and maintain the calling switch in the position to which it has been actuated, whereby the generator is maintained in circuit with the called subscriber's bell, an electro-magnet for withdrawing the detent from engagement with the switch, and switches at the subscribers' stations, each switch being adapted when its station is the called station to operate the magnet, the calling switch being adapted when thus disengaged from its detent to resume its normal idle position to remove the generator from line.

Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, OCTOBER 2, 1897. No. 14

A Model Isolated Plant.

The increasing number of comparatively small lighting plants which have been installed for the lighting of private residences affords sufficient reason for the following description of one of the most modern and entirely complete plants that has, up to the present time, been put in operation. This is the plant installed for Mr. H. N. Higinbotham of Chicago at his country home near Joliet, Ill.

The first intention was to light the house by gas furnished from a plant which it was proposed to install upon the grounds, and with this in view the entire house was piped. Upon second consideration, however, it was decided to abandon this plan and to wire the building for incandescent lighting, placing the necessary machinery and apparatus in one-half of the building already set apart for the plant to be used for the heating of the house and conservatories.

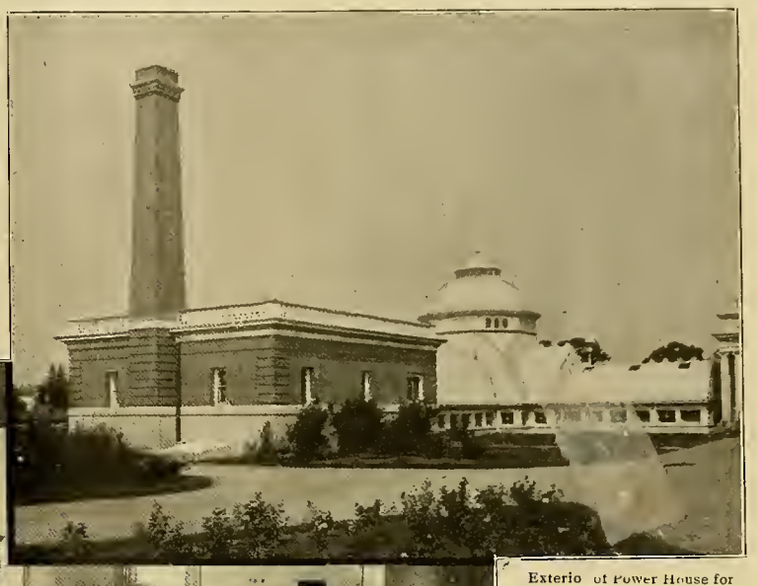
As the house was to be complete and furnished in every detail with the most modern appliances conducive to the comfort and convenience of the owner, it was necessary that the lighting plant should conform in every respect to the surroundings, nothing being omitted which would add to its completeness and the facility of operation. The professional services of Pierce & Richardson, consulting engineers, Chicago, were retained to this end, the matter being left entirely in their hands as to the arrangement and selection of apparatus. The work of laying out the plant, and of designing many special decorative and operative features, devolved upon Mr. S. G. Neiler, of the firm mentioned, and was executed in a manner that reflects credit on his engineering judgment and constructive ingenuity.

General Arrangement.

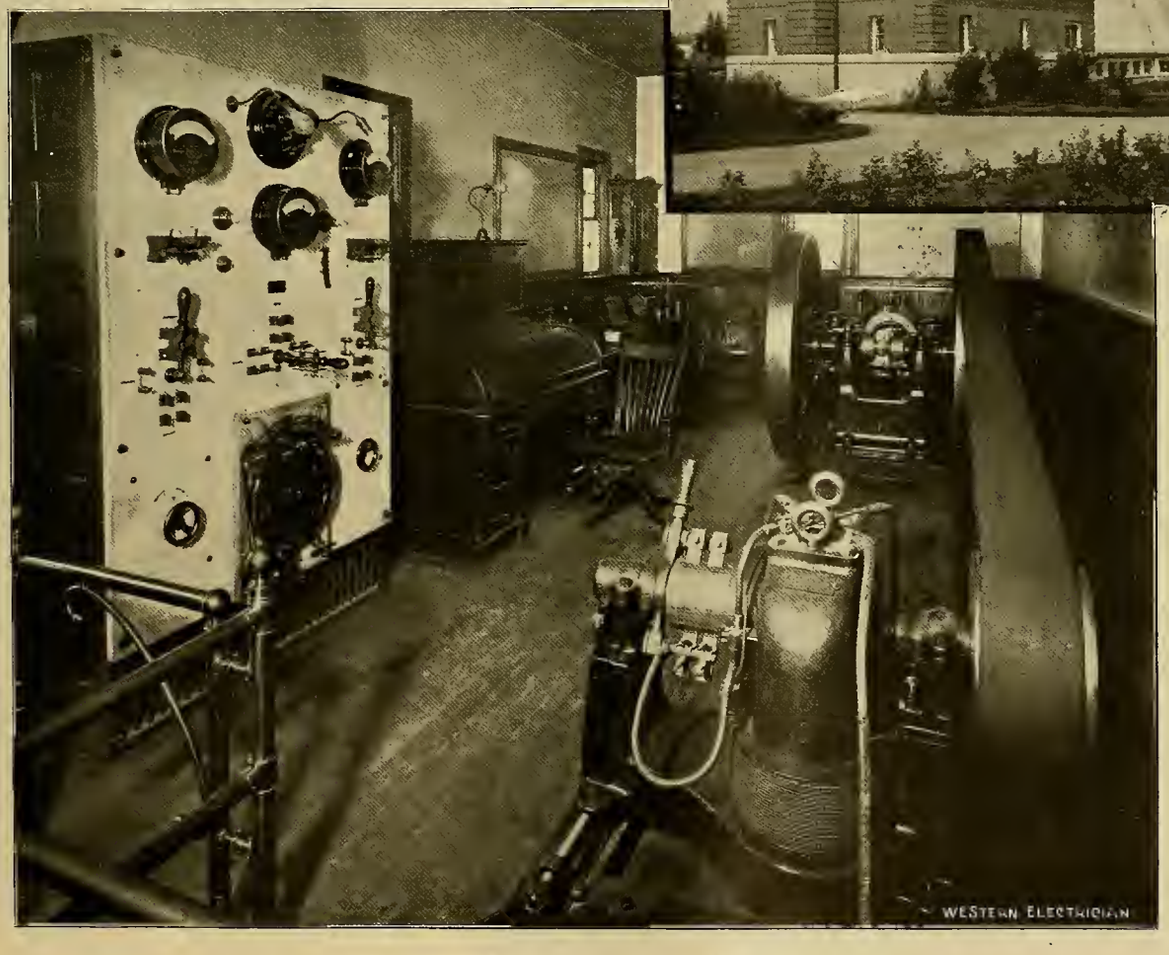
By a glance at the small picture giving a view of the house and grounds (Fig. 2, page 186), the reader will gain a general idea of the area to be supplied with current. The plant provides for the lighting of the house, stable, conservatories, grounds and the station itself.

The fixtures for the house were especially designed to suit the finish of the rooms; those for the reception room, for example (Fig. 3), being gold-leafed, the finish of this room being in old ivory and gold. The lamps for all fixtures are ground glass with the exception of the candelabra lamps, which are porcelain candle lamps made for this installation upon special order.

The lamp-posts used throughout the grounds formerly graced the exhibit of the Western Electric company in the Electricity Building at the World's Fair. As these posts were already on the ground, and it was desired that they be used, if possible, some special provision had to be made for lamps, as the capacity of the plant prohibited the installation of constant potential arcs. A novel idea was adopted, by which the regular constant potential arc lamp casings, without the mechanisms, were placed in the posts and a three-light incandescent cluster was suspended in the interior of each of the globes. This gives ample light, and at the same time the effect is all that could be desired, the opalescent globes diffusing the light and the whole having the appearance of the regular arc lamps. The special decorative wrought-iron posts upon the bridges over the waterways connecting artificial lakes were designed in the office of Pierce & Richardson and deserve passing remark, owing to the manner in which the lamps are attached. Through the center of the post a three-inch iron pipe is extended, reaching nearly to the top and is there finished with an ordinary cast-iron cap, this being tapped to receive a close nipple; the shade-holder is securely held in position on this nipple, between two nuts, around which compound was poured to prevent moisture entering the pipes. Above these nuts is fitted a reducing nozzle, to which the lamp socket is attached. As the shade-holders are solid, they were drilled to allow any water which might collect to easily run off. These precautions were necessary, owing to the fixtures being exposed to the weather, and as the lamps are placed in a vertical position. The whole is covered with an opalescent round electric ball shade, making a very attractive completed fixture. The lead-covered conductors are led directly from the manhole boxes to the lamp sockets, and, with the construction adopted, any possible trouble from moisture is entirely obviated.



Exterior of Power House for Heating and Lighting.



Interior of Engine Room, Showing Dynamo and Switchboard.

FIG. 1. A MODEL ISOLATED PLANT.

There is no special feature in the conservatory lighting or that in the stable; the latter, however, being most complete; three-point switches are placed in convenient places, permitting a certain portion of the lights to be operated from the several points.

The house is provided with a most complete burglar-alarm system, protecting all accessible openings. A special circuit is run to the stable for the extension alarm bell there installed; this circuit is provided with a relay which automatically brings a local circuit at the stable into operation, this latter circuit being furnished with an independent cut-out switch.

The house is in direct communication with the stable by a telephone line. The instrument at one end is located in the butler's pantry, while that at the other end is in the main carriage room.

Circuits.

All the circuits throughout the house are carried in iron-armored conduit. The feeder wires from the switchboard were led through a brick tunnel or subway, built for carrying the steam pipes for the heating system, through the conservatories to the basement of the building.

For the lighting of the ground, lead-covered conductors were drawn into galvanized iron pipes, leading from the end of the brick subway to each manhole in succession. These manholes were built of brick, as were also the foundations for the lamp-

posts, the covers being the same style cast-iron covers as were designed for the World's Fair.

For the stable lighting a galvanized iron pipe was laid between the lighting station and the stable, into which wires were drawn; a second pipe for the telephone and burglar-alarm wires was laid in the same trench, this pipe, however, being continued to the house where the telephone and burglar-alarm annunciators are placed.

The ground lighting was divided upon two circuits, each being provided with separate and independent switches at the cut-out cabinet located in the basement of the dynamo room. In connection with these circuits, Sechrist automatic magnetic switches were installed, the battery circuits connecting with them being run to the dynamo room as well as to the house, where were placed nickel-plated flush push-buttons for operating either or both of the circuits by merely pressing the button corresponding to the circuit it is desired to operate or cut out of service, as the case may be. Either set of pushes can be operated independently of the other. The ease with which the ground lights may thus be cut in or out, without going from the house, and the reliability of the system, render the arrangement especially convenient, as the storage battery could, in case of emergency, take care of these lights long after the dynamo plant had been shut down.

Dynamo and Battery Plant.

As has been stated, the plant is housed in a separate power house, which also contains the heating plant. This pretty little building is adjacent to the conservatory, and an exterior view of it is given in the upper picture in Fig. 1. The large picture shows the engine room, which is very neat and handsomely finished. The floor is made of narrow hardwood strips, oiled; the walls and ceiling are plastered and whitened, while a high wainscoting of narrow, matched and beaded hard pine, rubbed down in hard-oil, completes the building finish. A fine hand railing of polished brass with fancy swinging gate separates the machinery from the entrance way.

The dynamo is of the Crocker-Wheeler make, the manufacturers' rating being 10 kilowatts at 125 volts. A special pulley was provided and the dynamo speeded up sufficiently to generate a potential of 140 volts with the resistance nearly all cut out of the rheostat, as this potential is necessary for charging the storage battery plant. The dynamo is belt-driven from a Lewis gas engine of 17 horse power, running at 230 revolutions per minute, a five-inch Underwood cotton-leather belt being used.

The engine is operated by gasoline, the supply tank being located underground about 30 feet from the building line and connected by suction and overflow pipes with the engine. Generally, in ordinary gas-engine plants, a large water tank is conveniently located and so connected to the jacketed cylinder of the engine as to permit of a circulation of water about the cylinder. In the present case, however, connection was made through suitable valves directly to the main water supply pipe, thereby insuring a constant flow of cold water through the jacket, thus materially simplifying the arrangement as well as improving the general appearance of the plant. The engine is provided with an electric ignition device operated from storage batteries, connected through a four-pole double-throw switch, a diagram of the connections of which is shown in Fig. 4 (p. 187). The small 25 ampere-hour cells used for this purpose are located in the regular battery room. By inspection of the diagram it can readily be seen that while one set of three cells is discharging, the second set will be charging; thus always insuring one set being fully charged, as the discharge rate is necessarily less than the charging, owing to the intermittent spark required for ignition. The usual spark coil is inserted in the circuit leading to the terminals at the engine.

In the basement of the building, and almost directly under the switchboard, an ideal battery room has been built. A portion of it is shown in Fig. 5.

FIG. 2. A MODEL ISOLATED PLANT.—MR. HIGINBOTHAM'S COUNTRY HOME AT JOLIET.

The walls are brick, the inside being plastered and the floor cemented. The battery shelves were built of such size as to accommodate the elements installed; upon these shelves and resting upon special oil insulators are wooden trays containing sawdust in which the glass jars are set. Both shelves and trays are thoroughly painted with P. & B. paint, the acid having no action upon the wood when so treated.

The battery plant comprises 58 elements of the Electric Storage Battery company's chloride accumulator, type "E-11," in glass jars, so arranged as to be readily accessible in event of repairs being necessary. This battery has a normal rating of 250 ampere-hours, and, as advertised by the manufacturer, will stand a discharge rate of 50 amperes for four hours. The battery, with the new Manchester positive plates, which were furnished about eight months after the first installation, has been in use for about six months and apparently is in as good condition to-day as when the new type plates were substituted. The battery is arranged so that the 15 end cells are automatically cut in or out of service as the load demands, so as to maintain the line pressure constant.

All the wires are led directly from the battery to the switchboard through an opening in the wall of the battery room left for the double purpose of conductor space and ventilation.

FIG. 3. A MODEL ISOLATED PLANT.—FIXTURES IN RECEPTION ROOM.

Switchboard.

Upon entering the dynamo room the switchboard stands immediately to the left (Fig. 1), a polished hard pine panel inclosing the end, giving a finished appearance to this part of the board. It is of polished white Tennessee marble, the instruments being mounted on the face of the board and all connections made at the rear. The diagram of wiring (Fig. 6, p. 188) clearly shows all connections and can be easily traced out. While seemingly complicated, the connections are quite simle. The interesting part of the entire installation, from an engineer's point of view, centers in the switchboard. The comparatively new devices, and yet the multiplicity of combinations which can be made, render a detailed description desirable.

The ammeters and voltmeters are the standard round-dial pattern Weston instruments. At the bottom of the diagram of the switchboard connections is shown an automatic end-cell switch, the detailed connections of which are shown in Fig. 7. This switch was designed especially for this installation, the object being to maintain a constant potential of 110 volts at the center of distribution in the house, whether the batteries were being charged while the dynamo was furnishing light direct, or whether the batteries were supplying current with the dynamo idle. The switch is controlled by a small motor connected across the battery circuit as shown in the diagram. This motor is connected by a belt to a worm, operating the worm-wheel, which is connected to a movable contact arm. This arm is so connected that when moved in one direction some one or all of the 15 end cells are cut in service and when moved in the opposite direction the cells are out of service, but as they are discharged, the switch automatically cuts in cells so as to maintain a potential at the center of distribution of approximately 110 volts. The motor in connection with this switch is operated, stopped, reversed and again started by the action of a potential indicator located at the top and in the center of the board, the connections to the same being clearly shown in the diagram of details (Fig. 6).

In addition to this automatic end-cell switch, there is a full accompaniment of automatic overload switches and overcharge and discharge switches.

At the back of the board there is placed a motor-starting box so connected that when starting the plant the battery current can be used to run the dynamo as a motor and thereby get the engine up to speed before the gas is turned into the engine at all. This is a most convenient adjunct to the operation of a gas-engine plant and makes a very easy and convenient means of starting the plant.

The double-scale battery-charging ammeter is so arranged and connected that when the dynamo is charging the batteries direct the ammeter indicates to the left, and when the load is increased to such an extent as to exceed the capacity of the dynamo and the batteries are called into service, the battery ammeter will indicate in the opposite direction, which shows a discharge.

The maximum load of the dynamo is 80 amperes, but when running in connection with the battery, the load can be so divided by manipulating the rheostat that the dynamo can carry the entire load up to this amount, the battery in such cases acting as an equalizer in maintaining a constant pressure on the lines and may, in such case, indicate either charge or discharge, according to the requirements.

In Fig. 1, at the end of the switchboard, there will be noticed a small switch-plate with two light and two dark buttons. These are the Sechrist switches at the station already referred to.

From the start, the plant has been under the direct charge and supervision of Mr. J. D. Thompson, to whom praise is due, as the plant has operated very successfully and is certainly a model isolated combination dynamo and battery plant.

Municipal Officers Meet.

The meeting of mayors, aldermen and other city officials at Columbus, Ohio, this week, considered the subject of municipal ownership of lighting and railway plants.

Mayor McVicar of Des Moines, Ia., read a paper on "Street Lighting by Contract and by Municipal Ownership."

He said that the local companies made a vigorous campaign to defeat the proposition authorizing municipal ownership of a plant in Des Moines, money and political influence being freely used, but the vote was favorable by nearly three to one. The plant is not yet built, owing to suits threatened by prominent taxpayers under the direction and advice of the attorneys of the local companies. He continued: "While we now generally concede the justice of municipal ownership of waterworks and are about ready to indorse municipal street lighting, we hesitate at going further and declaring for city ownership of such natural monopolies as gas and street railways. However, we are rapidly coming to believe in the soundness of this principle."

The Chicago Tribune succeeded in working up a sensation in connection with the meeting by charging the General Electric company with an attempt to pack the convention with opponents of the municipal ownership idea. The basis of this statement was a letter sent out by William J. Clark, general manager of the railway department of the General Electric company, in which he said:

I have reliable information to the effect that extraordinary efforts will be made to have the convention declare itself in favor of municipal ownership of street railway, gas and electric lighting companies, and similar corporations, or, at least, to place heavier burdens upon them. It is expected that those city officials who favor the theory mentioned will constitute the majority in attendance unless speedy and extraordinary efforts are made by those most interested to secure the attendance of city officials who view the problem from a different standpoint.

Therefore, I would respectfully suggest the advisability of your consulting with the officials of other interested corporations in your city and having such action taken as is possible to secure the attendance at the convention of city officials who do not believe in municipal ownership and operation as against private corporations. I should, perhaps, explain that I am sending out this letter at the urgent request of certain of my friends representing large street railway and lighting interests—not in any desire to be officious in matters directly affecting local interests.

Municipal Ownership in Philadelphia.

[From the New York Sun.]

Philadelphia is the chief American city which owns its gas-plant. Artificial gas as an illuminant was first made in the United States in 1806. A gas company was chartered in Baltimore in 1816; one was chartered in Boston in 1822, and New York adopted gas for illuminating purposes in 1825. Ten years ago gas was introduced into the city of Philadelphia by a private company, the municipality reserving the right, on stated terms, to buy out the stockholders, which was done in 1841, more than half a century ago. The United Gas Improvement company, a private concern, is now seeking to get from the city a lease of its gas-works, and the city authorities, after more than 50 years' experience with "municipal ownership" of gas-works, are desirous of disposing of them under such lease. The city solicitor, whose position corresponds with that of corporation counsel in the city of New York, has sent to the chairman of the Philadelphia Council committee on finance and water an opinion to the effect that the city authorities have the right to make the lease, his conclusion being in the words following:

In the existing condition of the law upon the entire subject I am obliged to advise you that, in my opinion, the city has a right to make a lease of its gas-works if authorized by an ordinance.

At the hearing on Tuesday some facts were disclosed which show how in practical operation "municipal ownership" of gas works in Philadelphia. The area of Philadelphia is 129 square miles and the number of gas lamps in the city is 17,500. The current expenses of the Bureau of Gas amount to more than $3,000,000 a year and the city's loss on gas amounts to about $150,000 a year. The gas burned in Philadelphia is sold at a rate no cheaper than in some other American cities in which the municipality has nothing to do with supplying it, and moreover, the quality of the gas furnished in Philadelphia by the city is, as all travelers can attest and all candid Philadelphians admit, inferior.

Col. A. K. McClure, one of the speakers at the public hearing in Philadelphia on Tuesday, said:

We have very bad gas in Philadelphia. I doubt whether any other city in the Union has as bad gas as we have. You have lost thousands and thousands and scores of thousands, yea, hundreds of thousands of dollars in this city because your gas is unfit for use. This is a fact that none will dispute. Men have given all manner of theory, but we must look at the facts, and unless Philadelphia shall produce a better quality of gas, in five years from this time probably as much as 25, 30, or even 40 per cent. of the gas will be supplanted by electric lights. Our gas-works do not pay. They are to-day a positive loss to the taxpayers of this city. They show in a year a loss of nearly a quarter of a million dollars.

The reasons assigned by Col. McClure for the failure of municipal ownership of gas-works in Philadelphia are the same as are to be found generally. The gas plant is imperfect, primitive, not up to date, and insufficient for the requirements of the city. The management of the gas-works, instead of being in the hands of business men desiring to operate them for profit and compelled by competition to furnish the satisfactory supply at a proper rate, are under the direction of politicians of no particular knowledge on the subject and without the incentive to furnish the city with the best service posible. John C. Bullitt, one of the speakers at Tuesday's meeting in advocacy of the policy of leasing the gas-works, now operated under municipal ownership, to the corporation which is bidding for the lease, said:

The private organizations who are stimulated by their interest can unquestionably secure greater efficiency and better service in manufacturing enterprises. Another difficulty in the management of the gas-works by the city is this: Judicious operation of such a large business enterprise requires that the persons managing it should be forehanded in the plant and in the preparations in reference to future business. Pipes will rust and give out. The size of the pipe fitted for the business will change from time to time. Extensions and expansions are required. New material and new methods are being from time to time required. All this renders inevitable the expenditure of very large sums of money. A municipal organization cannot properly meet the conditions and contingencies of the future.

In other words, as set forth in the arguments advanced by those who favor the withdrawal of the city of Philadelphia from the gas-making and gas-selling business after long experiment, it has proved to be a failure in operation, for the reason that the business is not as well conducted by public authority operating on political lines as it would or could be by a business corporation chartered by public authority and operating under public safeguard and under the competition of rivals to supply the municipal ownership of the gas plant acquired by purchase from private companies. Millions of dollars of unproductive investment are represented in the plant. The loss entailed each year upon the people of Philadelphia is from $150,000 to $250,000, variously estimated, but there is no claim or pretense of any profit, while the conditions established are such, by the municipal ownership of gas, that there is no business competition against the city, which enjoys a monopoly, and the quality of gas is so poor that the city's monopoly gets less value each year through the more extended use of electricity. It is not practicable for the city to "improve" its gas-works for the reason that there is no available fund out of which such improvement may be made, and if there was, the money would be disbursed not by those having familiar knowledge of the matter, experts in gas-making under the most favorable conditions, but by persons having no accurate knowledge of the matter whatever. Last year only $55,000 was set aside for permanent improvements in the city's gas-plant, a sum totally insufficient for the requirements of so large a city—an appropriation of thousands where several million dollars might perhaps be expended to advantage in the improvement of the plant.

It is under these circumstances in Philadelphia, where municipal ownership has been tried on a broad scale, and after 50 years of practical and unsatisfactory experience, that the leading and most active citizens of the city, representing both political parties and all elements of the population, are united in favoring a formal lease of the gas-works to a private corporation, getting back to the original starting point, which was the supplying of gas for public uses, not by the city itself, but by one or more corporations authorized to do it. One significant result of the operation in practice of the so-called "principle" of municipal ownership has been that when the director of the Philadelphia public works was asked to furnish on Tuesday a statement of the case for the guidance of the council, "giving the present value of the gas-works and a statement showing the assessed valuation of the buildings and grounds occupied, together with the quantity of water consumed by the gas-works," he stated in answer "that he was at work on his report, and expected to have it completed within a few days."

Municipal ownership as applied to gas-works in Philadelphia is not a success, and Tuesday's hearing of the application for the lease of the works illustrates this very clearly.

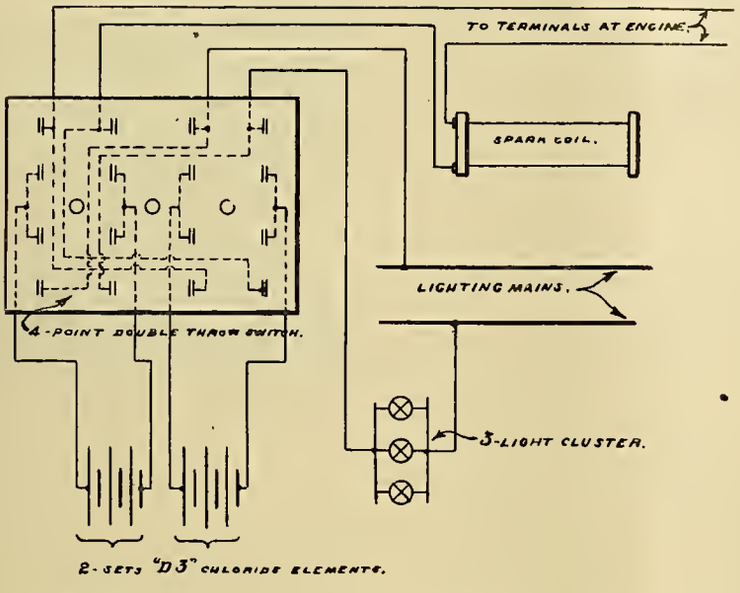


FIG 4 A MODEL ISOLATED PLANT.—DIAGRAM OF CONNECTIONS FOR GAS-ENGINE ELECTRIC IGNITION.

Canadian Tariff Duties on Electical Machinery and Supplies.

For the convenience of American manufacturers and exporters the State Department has issued a copy of the new Canadian tariff law now in force and known as the customs tariff of 1897. Those sections of particular interest to the electrical and allied interests are the following:

144. Acid, sulphuric, 25 per cent. ad valorem.

171. Lubricating oils, composed wholly or in part of petroleum, costing less than 25 cents per gallon, five cents per gallon.

175. Lubricating oils, not elsewhere specified, and axle grease, 25 per cent. ad valorem.

185. China and porcelain ware, also earthenware and stoneware, brown or colored, and Rockingham ware, white granite or iron stoneware, "c. c." or cream-colored ware, decorated, printed or sponged, and all earthenware not elsewhere specified, 30 per cent. ad valorem.

213. Skins for morocco leather, tanned but not further manufactured; sole leather and belting leather of all kinds; tanners' scrap leather; and leather and skins, not otherwise provided for, 15 per cent. ad valorem.

238. Iron and steel railway bars or rails of any form, punched or not, not elsewhere specified, for railways, which term for the purposes of this item shall include all kinds of railways, street railways and tramways, even although they are used for private purposes only, and even although they are not used or intended to be used in connection with the business of common carrying of goods or passengers, 30 per cent. ad valorem.

241. Locomotives for railways, not elsewhere specified, 35 per cent. ad valorem.

243. Forgings of iron or steel of whatever shape

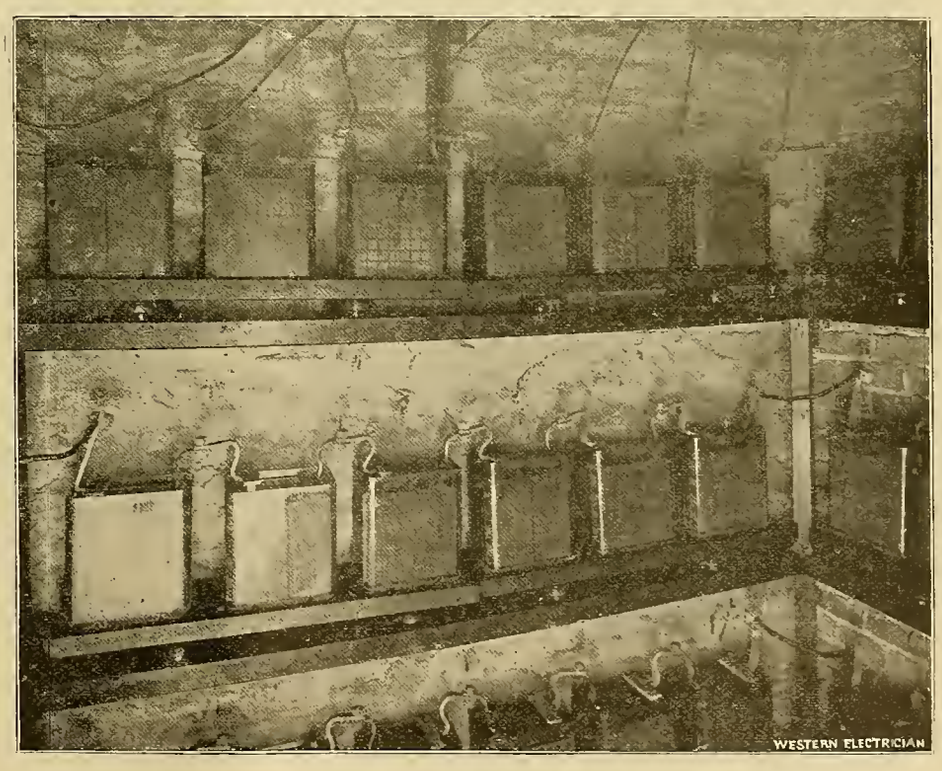


FIG. 5. A MODEL ISOLATED PLANT.—STORAGE BATTERY.

or size or in whatever stage of manufacture, not elsewhere specified; and steel shafting, turned, compressed, or polished; and hammered iron or steel bars or shapes, not otherwise provided for, 30 per cent. ad valorem.

249. Wrought iron or steel boiler tubes, not elsewhere specified, including flues and corrugated tubes for marine boilers, five per cent. ad valorem.

264. Wire, single or several, covered with cotton, linen, silk, rubber or other material, including cable so covered, not elsewhere specified, 30 per cent. ad valorem.

265. Brass wire, plain, 10 per cent. ad valorem.

266. Copper wire, plain, tinned or plated, 15 per cent. ad valorem.

267. Wire cloth, or woven wire of brass or copper, 25 per cent. ad valorem.

268. Wire of all metals and kinds, not otherwise provided for, 20 per cent. ad valorem.

269. Wire rope, stranded or twisted wire clothesline, picture or other twisted wire and wire cable, not elsewhere specified, 25 per cent. ad valorem.

272. Lead, old, scrap, pig and block, 15 per cent. ad valorem.

273. Lead, in bars and in sheets, 25 per cent. ad valorem.

275. Lead, manufactures of, not otherwise provided for, 30 per cent. ad valorem.

276. Brass and copper nails, tacks, rivets and burrs or washers; bells and gongs, not elsewhere specified, and all manufactures of brass or copper, not otherwise provided for, 30 per cent. ad valorem.

277. Zinc, manufactures of, not otherwise provided for, 25 per cent. ad valorem.

278. Nickel anodes, 10 per cent. ad valorem.

294. Telephone and telegraph instruments, electric and galvanic batteries, electric motors, dynamos, generators, sockets, insulators of all kinds; and electric apparatus, not elsewhere specified, 25 per cent. ad valorem.

295. Electric light carbons and carbon points, of all kinds, not elsewhere specified, 35 per cent. ad valorem.

296. Carbons over six inches in circumference, 15 per cent. ad valorem.

297. Lamps, side lights and headlights, lanterns, chandeliers, gas, coal or other oil fixtures and electric light fixtures, or metal parts thereof, including lava or other tips, burners, collars, galleries, shades and shade holders, 30 per cent. ad valorem.

298. Lamp springs, and glass bulbs for electric lights, 10 per cent. ad valorem.

299. Babbitt metal, type metal, phosphor tin and phosphor bronze in blocks, bars, plates, sheets and wire, 10 per cent. ad valorem.

315. Steam engines, boilers, ore crushers and rock crushers, stamp mills, Cornish and belted rolls, rock drills, air compressors, cranes, derricks, percussion coal cutters, pumps, not elsewhere specified, windmills, horsepowers, portable engines, thrashers, separators, fodder or feed cutters, potato diggers, grain crushers, fanning mills, hay tedders, farm wagons, slot machines and typewriters, and all machinery composed wholly or in part of iron or steel, not otherwise provided for, 25 per cent. ad valorem.

341. Vulcanized fiber, kartavert, indurated fiber, and like material, and manufactures of, not elsewhere specified, 25 per cent. ad valorem.

385. Oiled silk and oiled cloth, and tape or other textile india rubbered, flocked or coated, not otherwise provided for, 30 per cent. ad valorem.

Among other articles enumerated on the free list are philosophical instruments and apparatus, scientific, electrical and engineering books, copperas, blue vitriol, nickel, silex, electric or magnetic machines for separating or concentrating iron ores, platinum wire or bars, zinc in blocks, sheets and plates, and these brass, copper, rubber and gutta-percha products:

492. Brass and copper, old and scrap, or in blocks; and brass or copper in bolts, bars and rods in coil or otherwise, not less than six feet in length, unmanufactured, and brass or copper in strips, sheets or plates, not polished, planished or coated, and brass or copper tubing, in lengths of not less than six feet, and not polished, bent or otherwise manufactured, and copper in ingots or pigs.

573. Rubber and gutta-percha, crude caoutchouc or india rubber, unmanufactured; powdered rubber and rubber waste; hard rubber in sheets but not further manufactured and recovered rubber and rubber substitute.

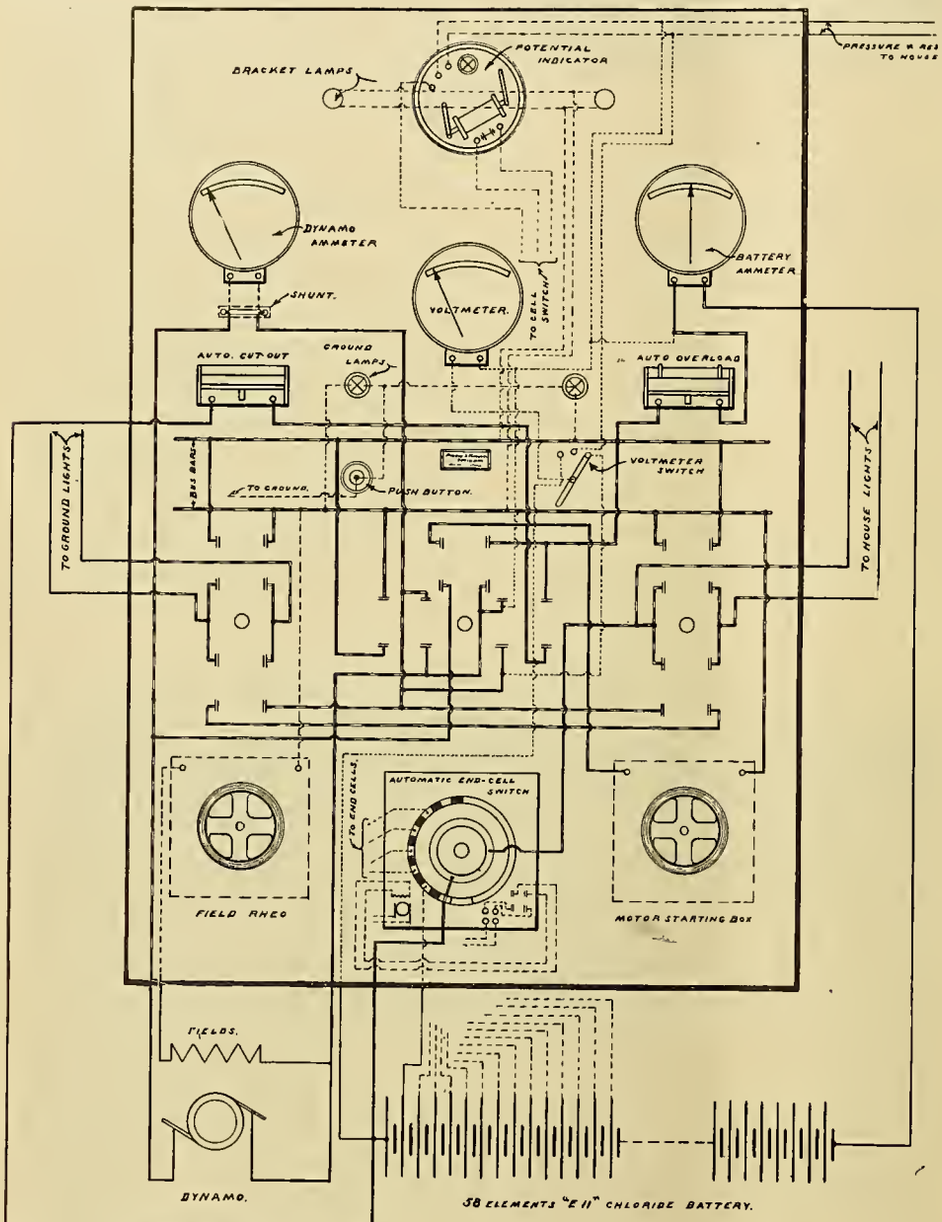


FIG. 6. A MODEL ISOLATED PLANT.—DIAGRAM OF SWITCHBOARD CONNECTIONS.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the Western Electrician.]

The Mutual Telephone company of Des Moines has received the second section of its switchboard on which 500 additional instruments can be connected, making a total of 1,000 in use.

The American Telephone and Telegraph company, which has been unable to get long-distance telephone connection into St. Paul, without accepting a burdensome franchise, is again working to secure a franchise there. The council wants the company to agree to give connection with any other local company securing a franchise.

The Elroy Telephone company has completed a line from Elroy to Wonewoc, Wis., and connects with Viroqua, La Crosse and other points.

The council committee on ordinances of Minneapolis is considering a repeal of the ordinances under which the Northwestern Telephone Exchange company works, it being proposed to pass another franchise which shall provide for a gross-earnings tax. The attorney for the telephone company has been before the committee vigorously opposing the repeal.

The St. Croix Valley Telephone company has been granted a franchise for a telephone exchange at Osceola, Wis.

An independent telephone company is an applicant for a franchise at Ottumwa, Ia.

Wire will be strung for the Portage-Lodi telephone line soon. A spur line will be built from Poynette to Arlington, Wis., and another to Columbus via Leeds and Hampden, Wis.

The Western Minnesota Telephone company has been granted a franchise at Glencoe, Minn., and will build from Glencoe to Hutchinson.

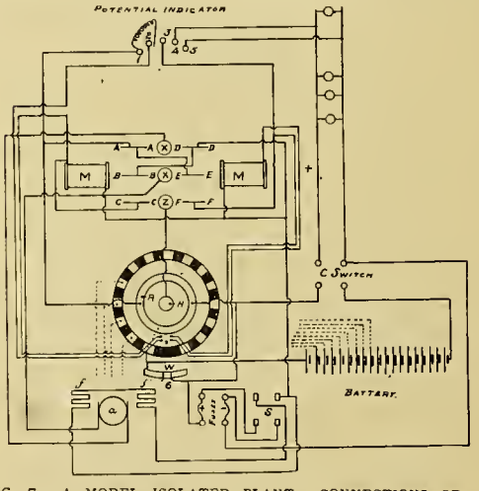


FIG. 7. A MODEL ISOLATED PLANT.—CONNECTIONS OF AUTOMATIC END-CELL SWITCH.

The Dakota Central Telephone company of Aberdeen, S. D., contemplates extending its lines to Ellendale, Monango and Edgeley, N. D.

Mondovi, Wis., is being canvassed for a telephone system.

The telephone exchange at Jackson, Minn., has just been opened, the Electrical Engineering company of Minneapolis furnishing the supplies.

The Northwestern Telephone company has begun work on the construction of a telephone line between Big Lake and Monticello, Minn.

Work is progressing on the line between Willmar and Minneapolis, Minn., and will be completed in 30 days, a crew having just started to work west from Cokato, to which point work has advanced, and one has started working east from Willmar. The distance is 43 miles.

Henry Brandenburg Released.

Judge Payne of the Superior Court has released Henry Brandenburg from the custody of the sheriff on a writ of habeas corpus. Brandenburg was held to the Criminal Court by Justice Underwood, on a charge of forgery, but the Superior Court held that there was not sufficient evidence given before the justice to bind him over to the grand jury.

The trouble involving Brandenburg came from his interests in the General Electric Railway company, together with those of Lucius Clark. A civil suit has been in progress between Brandenburg and Clark in regard to General Electric stock. The present case was a charge made by Clark that Brandenburg had forged a receipt for 10,000 shares of stock, which Brandenburg claimed he had placed in Clark's possession, and in which he claimed an interest. On behalf of the prosecution Clark testified that the signature on the receipt was not his, and experts corroborated his statement. The defense produced testimony to show that Clark had admitted that he had signed the receipt. The Superior Court held that the crime of forgery as against Brandenburg could not be presumed on this evidence.

Casselton, N. D., will take bids for furnishing an electric light plant.

COMMUNICATION.

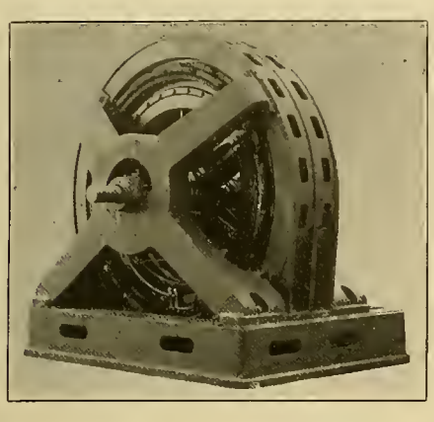
Large Induction Motors.

To the Editor of the Western Electrician:

In a recent issue of your paper we notice an account of a 400 horse power induction motor by the Westinghouse company, which is described as the largest ever made.

As the speed of the motor is not given, it is difficult to judge of its size, but, as it is not described as built for specially slow speed, we suppose it runs at about three or four hundred revolutions per minute.

We beg to point out that we have two of our induction motors running for over a year and a



LARGE INDUCTION MOTORS.

half, giving 300 horse power each at the exceptionally low speed of 200 revolutions per minute. These motors are coupled directly to the main shafts of a cotton mill in Italy, and run day and night at full load. They are built for a voltage of 3,000, with 50 periods per second. During the tests it was founnd that they would give out their full power, even if the voltage were reduced by about a third, thus demonstrating that they have a very large margin of power.

The accompanying illustration shows the general appearance of the motor, and it will be seen that the process of evolution has produced a remarkable similarity in the design of these two motors from opposite sides of the Atlantic.

We may add that we have had motors of 100 and 200 horse power for tensions up to 5,000 volts in use for the last four years.

BROWN, BOVERI & CO.

Baden, Switzerland, September 17, 1897.

Lord Kelvin at Schenectady.

Lord Kelvin, accompanied by Lady Kelvin, Count di Brazza-Savorgnan, Spencer Trask, Alanson Trask, R. R. Bowker and Professor Elihu Thomson, visited the works of the General Electric company on September 23d. He was met by Captain Eugene Griffin, Joseph P. Ord and E. W. Rice, Jr., the three vice-presidents of the company, and S. Dana Greene, manager of the lighting department. In addition there were present W. F. Merrill, vice-president and general manager of the Erie railroad, Dr. Louis Dnucan, Dr. Cary T. Hutchinson, Frank J. Sprague, T. C. Martin, Chas. W. Price, H. G. Prout, C. T. Childs, J. J. Swan, W. J. Clark, W. B. Potter, A. H. Rohrer, C. P. Steinmetz and others.

The opportunity given Lord Kelvin by his attendance at the meetings of the British Association at Toronto, of visiting the United States and appreciating the enormous strides made by electricity since he was last here in 1884, was one of which he has as fully availed himself as the time at his disposal permitted. He has been able to see a large number of electrical installations, including the works of the General Electric company at Schenectady.

Under the immediate care of Professor Thomson and E. W. Rice, Jr., Lord Kelvin was conducted through the works, starting at Building No. 9, where the heavy machinery is constructed. This building was crowded with dynamo parts in all stages of completion. All the machinery in the shop is operated by electric motors, and many are so arranged that the work may be kept stationary while the cutting mechanism is moved from point to point as the operations require. This building contains some very large planers, and the largest boring mill ever built.

From this building the party passed into the testing room, where every machine is subjected to rigid test before shipment. Connected to this building and forming a part of it is the machine shop and shipping department, a total length of 1,320 feet, all under one roof, with electric traveling cranes running from end to end carrying the unfinished parts to their respective assembling points, and the finished machines finally to the shipping department end. In planning this building everything was disposed for handling the machinery with the utmost rapidity and precision. Ranged down both sides of the central aisle stood machines of all sorts and sizes, from that with a capacity of some 15 or 20 16 candle power lamps to those built to supply current to the enormous number of 30,000 lamps. One of the latter machines had just been shipped to Brooklyn, the parts making five complete carloads. Seven 1,500 horse power railway generators were in process of completion for the Fourth and Sixth avenue lines of the Metropolitan Traction company, and two of 2,000 horse power each for Boston. Under test were two 1,000 horse power three-phasers for the Lachine Rapids plant, five of 800 horse power each for the great works at St. Anthony Falls, Minneapolis, together with the 1,250 horse power 20,000 volt transformers for use at Niagara Falls and Buffalo and five 700 horse power rotary converters for St. Anthony Falls. Lifting its respectable height to the roof, was one of the 1,200 horse power smooth-body armature machines for the Edison Electric Illuminating company of New York, almost ready for shipment.

From this building the party passed into the power house, in which Lord Kelvin was shown an interesting collection of dynamos, including many of the older types of machines, as well as some of the most recent, all in operation, furnishing power to each department through a system of underground conductors. The next building visited was No. 15, in which the great part of the armature winding and the manufacture of armature coils is carried on. Here Lord Kelvin was shown examples of the recently developed "G E" revolving-field alternators, dynamos with revolving fields and stationary armatures—a method of construction adopted to allow of more perfect insulation for high voltages, while eliminating collector rings and moving contacts. In long-distance transmission work such dynamos as these can be wound for the high voltages necessary for the transmission lines and step-up transformers can be dispensed with. Wound for a pressure up to 15,000 volts, they are subjected to very high voltage tests, the 1,000 kilowatt three-phase alternator for the Brooklyn Edison company being tested in the presence of Lord Kelvin under a pressure of 25,000 volts. The distinguished visitor was too late to see the 2,000 kilowatt machine for the same company, which left the works on the day previous. The diameter of this machine is 25 feet. It weighs 163,000 pounds and is, perhaps, the largest dynamo ever built in point of size. Its speed is 75 revolutions, the field being keyed directly to the engine shaft.

An interesting experiment in high-voltage currents was then made by Mr. C. P. Steinmetz. An arc was sprung between two metallic points, some 15 inches apart, with the current at a pressure of 180,000 to 200,000 volts, and drawn out to a length of about five feet, until it could no longer hold.

Passing from Building 15 to Building 12, Lord Kelvin was shown the principle of Professor Thomson's magnetic blow-out. A current of 1,000 amperes at 500 volts was passed through an automatic circuit breaker, and the extinction of the arc instantaneously fully demonstrated. To show the effect of the magnetic blow-out on a blown fuse, the magnetic fuse-box was brought into requisition and the same test applied. The blown fuse withdrawn showed the very small amount of metal melted, as the arc was created and extinguished. The railway motor testing department was next visited, and the method of testing railway motors under very severe conditions explained.

The party then proceeeded to the rear of Building 23, where the new surface-contact system of the General Electric company was shown in actual operation, with all the working details visible. The advantages of such a system for city streets were quickly appreciated. The overhead trolley wire is superseded by a series of small cast-iron disks set in the pavement in parallel rows between the rails of the track, each disk convexed to about one inch above the surface, at distances of about four feet. The disk near to one rail is the positive disk, that near the other the negative disk. In this system only those disks immediately under the car are alive; all the others are without current. The current is brought to the positive disks by an automatic magnetic switch, which is set with a number of others in a manhole, instead of being buried in the street near to its own disk. The car is provided with a small storage battery and with two long shoes suspended beneath it, touching always one or two disks. To start the car, current from the battery is let into the shoe. This energizes through the disk the coil in the automatic switch, and establishes connection between the feeder circuit and the motors. All leakage is taken care of by placing the negative disks in a cast-iron box, which acts as a shield and effectually takes care of any wandering current. Sparking in the automatic switches is prevented by providing them with magnetic blow-outs.

After witnessing the operation of this system, the party mounted the searchlight tower, whence a splendid bird's-eye view of the entire works was had. Descending this the party was grouped at the base and photographed.

The electric brake for electric cars was shown to Lord Kelvin on car No. 9 of the Schenectady street railway. This brake practically gives the motorman an automatic and instantaneous check on the motion of the car, the brake being applied by the same single movement of the handle of his controller which cuts out the current from the motors. It consists of two steel disks, one of which contains a coil of wire; the other is a plain metal disk. The moment the car is stopped and no current is flowing from the controller the motors become powerful dynamos, which turn their current into the coil of that one of the disks which is attached to the motor. It then becomes a strong electro-magnet with a great power of attraction. The other disk is revolving on its axle, but the moment the first disk becomes an electro-magnet its attraction is so powerful to the surface of the latter that it is brought to a standstill, and with it the car. Should the wheels skid as on an incline, the amatures of the motors naturally stop; the disks separate, the wheels begin to revolve again, and the moment they do so current is generated in the motors, and the disk with the coil becomes an electro-magnet and the car stops again. In other words, the brake is always in operation once it is applied.

Asked to express an opinion on his visit, Lord Kelvin said: "I am enjoying myself very much and learning enormously. There are no shops in the world like these; they are among the great wonders of America."

Lord and Lady Kelvin and immediate party were entertained at luncheon by Mr. and Mrs. S. Dana Greene, and then left for Boston with Prof. Elihu Thomson and Mr. J. P. Ord.

LORD KELVIN AT SCHENECTADY.

Chicago Electrical Association.

During the fall and winter semi-monthly meetings of the Chicago Electrical association will be held as usual at 1737 Monadnock building. The list of papers now announced is as follows:

October 1—"Economy in Electric Car Control," by James R. Cravath.

October 15—"Evolution of the Isolated Electric Plant," by Harold Almert.

November 5—"The Safe Current Capacity of Electrical Conductors," by C. H. Sewall.

November 19—"Daily Mathematical Conveniences," by S. G. McMeen.

December 3—"Heavy Electric Traction," by Cloyd Marshall.

December 17—"Electricity in Ship Building," by C. C. Mattison.

January 7—"Electrical Shop Transmission," by H. G. Dimmick.

January 21—"The Art of Constructing Telephone Apparatus," by Henry P. Clausen.

Rails for the interurban railway have arrived at Menasha, Wis., and tracklaying will be begun soon.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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CIRCULATION, 20,000.

State of Illinois, County of Cook—ss:

Thomas Jansen, being duly sworn, deposes and says that he is a resident of the city of Chicago, in the county of Cook and state of Illinois, and that he is the foreman of the printing department of the Electrician Publishing company, the publishers of the Western Electrician; that he was present at and superintended the printing of No. 24 of Vol. 20 of the Western Electrician, issued on June 12, 1897, and that there were printed by actual count 20,000 complete copies of said Western Electrician of the volume and number above specified. And further this affiant sayeth not.

THOMAS JANSEN.

Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

Four Years' Record of Electric Light Convocation Advertising.

Issue	Number of Advertising Pages.	Whole Number of Pages.	Square Inches of Paid Advertising Matter.
March 3, 1894....	40	56	4,145
February 23, 1895.	52	68	5,593
May 9, 1896.....	72	88	7,576
June 12, 1897.....	80	100	8,643

No other electrical journal has ever equaled this record of 8,643 square inches of genuine full-paid advertising in a single issue.

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The season has fairly opened and meetings of technical bodies are announced with the regularity and punctuality of old. The American Institute of Electrical Engineers started in this week, and the Chicago Electrical association also held the first meeting of this season. May the season prove not only entertaining and instructive, but prosperous as well, for organizations and members.

An ordinance has been passed by the Chicago City Council requiring the street railway companies of the city to equip their cars with fenders. The idea is an excellent one and should be put in force at once. Furthermore, the street railway companies should be compelled to provide a better class of braking and regulating apparatus than that now employed on many lines.

The "wave of prosperity" has not struck Chicago promoters yet. These enterprising gentlemen have a large stock of franchises of more or less value on hand. The Commonwealth ordinance was passed around quite freely for inspection last week, but no one seemed disposed to invest; the General Electric Railway company's franchise has been knocked about so freely that it may now be considered damaged property, and the Metropolitan Traction is following so closely in its coures that, despite its present influential backing, it bids fair to meet the fate of many a good thing that has gone before it.

The character of the meeting to be held at Niagara Falls next month by the American Street Railway association can be fairly judged by the official programme, which is presented on another page, and the list of exhibitors who will participate in the display to be made in connection with this year's convention. Electrical subjects predominate, and it is noteworthy that the only forms of propulsion to be considered are those employing electricity. The fact, too, that the principal exhibitors at the convention will be electrical companies is of interest. The entire meeting will partake of the nature of an electrical gathering and will have unusual interest for electrical men.

Discussion of the Allen law and the extension of franchises generally has been precipitated by the action of the street railway companies at Peoria in petitioning the City Council to grant the full measure of relief to be enjoyed under the new law. There are complications in this controversy which will probably make the corporations' position much harder to sustain than it would otherwise be. The Peoria ordinance provides for license fees or taxes, the same as the companies now pay. It also provides that the fare shall not be reduced below five cents for a period of 20 years. If at the end of that time the council shall reduce fares to three cents the existing taxes and license fees on the lines of the company shall cease. The matter has not been finally determined, but it is believed the company will secure what it wants.

Fifty years' experience in the operation of its gas-plant has convinced the city of Philadelphia that municipal ownership is not desirable, and many of the leading citizens, representing both political parties and all elements of the population, have joined in a formal indorsement of the proposition to lease the city gas-works to a private corporation. The city of Philadelphia has supplied gas of the poorest quality for public and commercial use; there has, of course, been no competition; consequently, while the service has been wretched the price has been high, and all this time the city has been losing money. Nobody seems to know just how much this loss has been, although it has been variously estimated at $150,000 to $200,000 annually. The business has been conducted much in the same manner as all municipal enterprises of this character, no attempt being made to secure exact data upon cost of production and distribution. During a public hearing, at which the city officials in charge of the plant were present, it was admitted by the head of the Department of Public Works that he had no data at hand that would enable him to give an intelligent idea of the value of the city gas-plant, the assessed valuation of the property occupied, the quantity of water consumed or the value of the output. Of course no better results could be expected under such management, and yet the same character of public service is to be found throughout the country wherever public works are conducted by political bosses.

The question has been raised as to whether a railroad upon which electricity is used as the moving power continues to be a railroad in the full sense of the word, especially within the provisions of such a statute as one providing that when the tracks of two railroads cross each other, engineers and conductors must cause the trains of which they are in charge to come to a full stop within 100 feet of such crossing, and not proceed until they know the way to be clear, and giving the train on the railroad having the older right of way the right to cross first. In the case of the Louisville and Nashville Railroad company against Anchors, where a rehearing was denied, June 29, 1897, it was contended that the railroad of the Oxford Lake line, an electric road running from Anniston to a point beyond the corporate limits of the city, was not a railroad within the meaning of the foregoing statute, but the Supreme Court of Alabama held that it was, and says that the statute itself makes no distinction, and, in considering the purposes intended in the adoption of these regulations, it is unable to see any good reason why persons traveling upon electric cars are not entitled to the same protection as those traveling upon cars propelled by steam. Public necessities, even within city limits, demand increased facilities for travel over the horse car: and many decisions of courts applicable to street railways operated by horses could not be applied without manifest injustice to trains operated by steam or electricity. The speed, economy and convenience afforded by electricity commend its use, even for commercial purposes, as well as travel, as superior in some respects to any other motive power thus far applied. Consequently, the court concludes that a railroad within the provisions of the statute does not cease to be a railroad because it may discontinue the use of steam and substitute that of electricity. The change in the motive power may relieve it from some provisions of the statute, but those which are needful for the protection of life and property continue in force.

Certain members of the Chicago City Council demand information regarding the management and operation of the street railway lines in the city before extending the franchises under the Allen law. Among the points enumerated upon which information is desired are the following:

What lines of street railway are now operated by each company and under what franchises, and specifying the dates when the franchises expire respectively.

An inventory of all the tangible property of each street railway company, its original cost and present cash value.

The gross receipts of each company during each year of its existence.

The operating expenses and fixed charges paid by each company during each year of its existence.

The amount and rate of dividends paid by each company during each year of its existence.

The amount of capital stock of each company and the average market value thereof during the year 1896 and prior years so far as may be deemed material; also the date, amount and purpose of each issue of stock and the consideration for which it was disposed of.

The amount of bonded indebtedness of each company at the present time, and the annual interest thereon, and for what purpose such bonded indebtedness was created.

The amounts paid into the public treasury by each company for taxes, licenses or other public purposes during each year of the existence of the company.

The number of passengers carried and the number of transfers issued by each company in the year 1896, and in previous years so far as may be deemed material.

The amount and value of all donations, bonuses or other payments of any kind received by each company at any time for the extension or building of any line of street railway.

The amount of capital lost by any company at any time by reason of a change of motive power.

The scale of wages paid employes by each company and the conditions of employment.

It is contended that the public is entitled to this information, and, moreover, that it must have it in order to reach a fair decision upon the conditions which should govern the granting of the desired extensions of the franchises.

American Street Railway Association.

Arrangements have been completed for the sixteenth annual meeting of the American Street Railway association at Niagara Falls, N. Y., beginning on Tuesday, October 19th, and continuing four days. It has been decided to hold one business meeting each day, beginning at 10 o'clock in the morning the first day and 9:30 thereafter and continuing until the work laid down for the session is completed. The afternoons will be devoted to sight-seeing and the evenings to general amusement. There will be plenty of music for those desiring to dance, and concerts will also be provided, which will no doubt prove a pleasing feature. The programme, including each day's features in their order, is as follows:

TUESDAY, OCTOBER 19TH, 10 A. M.

Meeting called to order by President Robert McCulloch.
Address of welcome by the Hon. A. C. Hastings, mayor.
Calling of the roll.
Invitation extended to join the association.
Address of the president.
Report of the executive committee.
Report of the secretary and treasurer.
Reading of paper on "Municipal Ownership of Street Railways," by P. F. Sullivan, general manager Lowell and Suburban Railway company, Lowell, Mass.
Reading of paper, "Some of the Difficulties Existing in the Construction and Operation of Electric Street Railways," by G. W. Knox, electrical engineer Chicago City Railway company, Chicago, Ill.

ENTERTAINMENT, 2:30 P. M.

A visit will be made to the power house of the Niagara Falls Hydraulic Power and Manufacturing company, after which the cars of the Niagara Falls and Suspension Bridge Railway company will convey the party to the power house of the Niagara Falls Power company and the factories of the Niagara Falls Paper company and the Carborundum company.
Pleasant entertainment will be provided in the evening at the hotels, including music, dancing, etc., and a trolley party excursion to Whirlpool Rapids.

WEDNESDAY, OCTOBER 20TH, 9:30 A. M.

Reading of paper on "Application of Storage Battery to Electric Traction," by Charles Hewett, electrical engineer Union Traction company, Philadelphia, Pa.
Reading of paper on "Power Distribution and Use of Multiphase Curent Transmission for Ordinary Street Railways," by Maurice Hoopes, electrical engineer Lynn and Boston Railroad company, Lynn, Mass.
Appointment of committe on nomination of officers and next place of meeting.

ENTERTAINMENT, 2:30 P. M.

Party will walk across the upper suspension bridge to the Canadian side, where the cars of the Niagara Falls Park and River Railroad company will convey party to Chippawa and Queenston, where the steam ferry of the Niagara Falls Navigation company will be taken to Lewiston, thence by the Niagara Falls and Lewiston Railroad company (Great Gorge Route) through the gorge to Niagara Falls.
The committee will provide pleasant entertainment in the evening.

THURSDAY, OCTOBER 21ST, 9:30 A. M.

Reading of paper on "Discipline of Employes," by George H. Davis, superintendent of Canal and Claiborne Railroad company, New Orleans, La.
Reading of paper on "Application of Electricity to Railroads Now Operated by Steam Power," by H. N. Heft, president Meriden Street Railway company, Meriden, Conn.
Reading of paper on "Best Method of Settling Damage Cases and Prevention of Accidents by Use of Fenders or Otherwise," by C. G. Goodrich, vice-president and general manager Twin City Rapid Transit company, Minneapolis, Minn.
Election of officers.

ENTERTAINMENT, 9:30 A. M.

A trip will be arranged for the ladies to Youngstown and Fort Niagara over the Great Gorge Route and the Frontier railroad, in charge of ladies' reception committee assisted by gentlemen of the reception committee.
7 p. m. Annual dinner at the International Hotel.

FRIDAY, OCTOBER 22D, 9:30 A. M.

Unfinished business.
Installation of officers.
Adjournment.

Following are the officers of the organization for the present year:

President—Robert McCulloch, vice-president and general manager Citizens', Cass Avenue and St. Louis Railroad companies, St. Louis, Mo.

First vice-president—Charles S. Sergeant, general manager West End Street Railway company, Boston, Mass.

Second vice-president—D. B. Dyer, president Augusta Railway and Electric company, Augusta, Ga.

Third vice-president—C. F. Holmes, general manager Metropolitan Street Railway company, Kansas City, Mo.

Secretary and treasurer—T. C. Penington, treasurer Chicago City Railway company, Chicago, Ill.

Executive committee—H. M. Littell, vice-president and general manager Metropolitan Street Railroad company, New York; H. P. Bradford, general manager Cincinnati Inclined Plane Railway company, Cincinnati, O.; Charles H. Smith, general superintendent Troy City Railway company, Troy, N. Y.; Harry Scullin, vice-president and general manager Union Depot Railroad company, St. Louis, Mo.; George B. Hippee, general manager Des Moines City Railway company, Des Moines, Ia., together with the president and vice-presidents.

The local committees are made up of the following-named ladies an gentlemen:

General—Hon. A. C. Hastings, chairman; Hon. W. C. Ely, president Buffalo and Niagara Falls Electric Railway company; Charles B. Hill, treasurer Niagara Falls and Suspension Bridge Railway company; Capt. John M. Brinker, president Niagara Falls and Lewiston Railway company; W. A. Heller, superintendent Lewiston Frontier Railroad company; John Foy, general manager Niagara Navigation company; Col. Henry M. Watson, president Buffalo Street Railway company; H. H. Littell, president Crosstown Railroad company, Buffalo; J. M. Bostwick, treasurer Niagara Falls and Clifton Suspension Bridge company; W. Phillips, superintendent Niagara Falls Park and River railway; Burt Van Horn, general manager Buffalo and Niagara Falls Electric Railroad company; Frank LeBlond, manager Maid of the Mist Steamboat company; Hon. Thos. V. Welch, superintendent State Reservation; James Wilson, superintendent Victoria Niagara Falls Park; Hon. Arthur Schoellkopf, secretary and treasurer Niagara Falls Hydraulic Power and Manufacturing company; W. A. Brackenridge, engineer Niagara Falls Power company; Joseph P. Devine, L. W. Pettebone, Hon. James Low, A. H. G. Hardwicke, Wm. Richmond, Benj. F. Thurston, Wm. S. Humbert, W. H. Barnes, Walter McCulloch, Eugene Cary, Thomas McDowell, D. Isaacs, Gen. Benj. Flagler, Richard Williamson, Lawrence Davis, Andrew Dickey John M. Hancock, James Simmons, H. W. Beardsley.

Committee on banquet—Hon. A. C. Hastings, Hon. W. Caryl Ely, Hon. T. V. Welch.

Committee on exhibits—H. W. Beardsley, W. A. Heller, W. Phillips.

Committee on entertainment—W. S. Humbert, Hon. James Low, James S. Simmons, Mrs. W. C. Ely, Mrs. W. S. Humbert, Mrs. A. G. Hardwicke, Mrs. George Nye, Mrs. Burt Van Horn, Mrs. F. A. Dudley, Miss Bessie Low, Miss Grace Cuddaback, Mrs. J. M. Hancock, Mrs. M. Cohn, Mrs. Eli Nichols, Mrs. F. K. Paddock, Mrs. H. W. Beardsley, Mrs. W. W. Reed, Mrs. W. D. Hough, Mrs. E. H. Stewart, Walter McCulloch, David Isaacs, H. W. Beardsley, Mrs. A. C. Hastings, Mrs. H. E. Woodford, Mrs. F. W. Oliver, Mrs. H. A. Francis, Mrs. N. L. Benham, Mrs. F. E. Johnson, Mrs. E. O. Babcock, Mrs. C. W. Dill, Mrs. J. C. Morgan, Mrs. W. Richmond, Mrs. W. R. Campbell, Mrs. A. Thibaudeau, Miss Rose, Mrs. Thomas McDowell, Mrs. W. L. Lamont, Mrs. W. C. Johnson.

The International Hotel will be the headquarters of the association during the convention, as this is the favorite resort of the street railway men. It has accommodations for 600 guests, and on this occasion special provision will be made for the delegates and their friends. The house will be turned over to the street railway men practically, as the regular season will have closed.

Those attending the American Street Railway association convention at Niagara Falls, October 19th to 22d, will be interested to know that they may take the Lake Shore and Michigan Southern Limited, leaving Chicago at 5:30 p. m., October 18th and arrive at Niagara Falls, via Buffalo, at 8:30 on the morning of the 19th. The rate to Niagara Falls for this occasion is one and one-third fare ($18) for the round trip, on the certificate plan. This rate is available on the Limited eastbound, the extra fare heretofore charged on that train being discontinued. Sleeping-car reservations may be made in advance at the city office, 180 Clark street, Chicago.

A Woman's Electrical Work.

Electrical construction is one of the fields of work lately invaded by woman, if the following dispatch from Syracuse to the New York Sun is to be believed: The new Wieting Opera House, which has just been opened, was wired by a woman. Mrs. W. J. Blackburn of New York, wife of a theatrical electrician, came here on July 10th to execute for her husband the contract for the electrical work, and continued solely in charge of it until a few days before the opening. It was quite a complicated job, there being 1,250 incandescent lights for the auditorium, stage and lobby. Mrs. Blackburn makes a specialty of designing switchboards, and with her husband has wired many prominent theaters, including the new Manhattan in New York, the Montauk and Bijou in Brooklyn, and several in Chicago. Four years ago Mr. and Mrs. Blackburn removed to New York from Chicago, where they held permanent contracts with the Chicago Opera House and the Columbia Theater. Mrs. Blackburn says the work is fascinating, and as far as she knows, she is the only woman in the country who makes this a business.

American Institute of Electrical Engineers.

The Chicago branch of the American Institute of Electrical Engineers held a meeting at Armour Institute Wednesday evening to consider the "National Electrical Code," which had been referred by the executive committee to the Institute for discussion.

Angus S. Hibbard presided and R. H. Pierce opened the discussion. He said the only criticism he had to offer was not upon the code itself but upon the use to which it was sometimes put—a use for which it was never intended. Many architects and builders used it as a specification, whereas it was merely intended as a safety measure.

Other speakers were A. V. Abbott, S. G. McMeen, R. E. Richardson, C. E. Burton and W. H. Merrill. The general opinion seemed to be that the new rules were a great improvement on all former efforts in this line and that they should be given a fair trial.

Prof. Stine read the report of Dr. Crocker, who was the delegate of the Institute at the conference, in which he said:

The influence already exerted by the Institute in this matter has been most important; in fact, it is no exaggeration to say that the conference would have failed to accomplish its object had the Institute held aloof from it. The representative of the Institute was appointed chairman of the committee on code, which performed the actual work of revising the rules. The new code contains many amendments in regard to the technical requirements, and in form it has been entirely revised. This latter fact is particularly important, as previous codes had become a patchwork, containing many repetitions and interpolations. This result alone is a sufficient reward for the labors of the conference. It is not claimed that the code is perfect, but it can be said that each word in it was carefully considered by a number of men representing the most diverse interests and points of view. If amendments are required in the future they can easily be made, the new arrangement of the code being specially designed to enable this to be done without injury to its general form. In view of the very great advantages to be obtained by the general adoption of one uniform code for the whole country, the fact that it has already been adopted by the most important bodies represented in the conference, and in order to complete the powerful and beneficial influence which the Institute has already exerted in this matter, your delegate earnestly recommends that the Institute give its approval to the "National Electrical Code." This action need not be an adoption of the code which would be in any way binding upon the individual members of the Institute. All that is necessary is that the Institute should approve the code as representing uniformity and cooperative action. One of the most important functions that the Institute can possibly perform is the encouragement and securing of the very uniformity which this code so well represents.

The following expression of opinion upon the subject was unanimously adopted:

Whereas, The rules and requirements for the installation of wiring and apparatus for electric light, heat and power, known as the "National Electrical Code," are the result of the united efforts of the electrical, insurance, architectural and allied interests represented in the national conference on standard electrical rules, composed of delegates from the American Institute of Architects, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Street Railway association, Factory Mutual Fire Insurance companies, National association of Fire Engineers, National Board of Fire Underwriters, National Electric Light association and Underwriters' National Electric association; and

Whereas, This code is shown to be the best at present available for use from the fact that it has been adopted by the various municipal and insurance inspection departments of the country, as well as by the National Electric Light association and the National Board of Fire Underwriters and other bodies; and

Whereas, Representatives of the American Institute of Electrical Engineers, headed by the present president of the Institute, were important factors in its compilation; therefore be it

Resolved, That the "National Electrical Code" be and hereby is indorsed for general use as a standard set of specifications governing the safety of electrical equipments, and further be it

Resolved, That this code be recommended to the board of managers for adoption as the standard of the American Institute of Electrical Engineers.

Trolley Freight Line.

The first electric road built for freight as well as passenger service in the West, and the first that steam roads would recognize and join in rate tariffs, has been in successful operation for three months, in Iowa, according to the Chicago Tribune.

The line was built by the Mason City and Clear Lake Traction company of Mason City, Ia., W. E. Brice being president and general manager of the company and L. H. Ong the general superintendent. Its construction is the same as a steam road, with 60 pound steel rails. Its motor cars will pull 12 loaded passenger cars or 10 grain or stock cars. The passenger coaches are large, being eight feet eight inches wide and 42 feet long, with a 33 inch wheel.

The overhead trolley system is used, but this road is in no sense a street railway. The passenger business is handled in exactly the same manner as a steam road. The company has two lines of street railway in Mason City, running from one end to the other of the main streets and connecting with the larger line.

The passenger part of the service has been the only part in use up to within the last two weeks, but the road has been in shape to handle freight since September 1st and has extended spurs into the lumber yards and stockyards which have just been completed, and are handling all the Iowa Central's business and that of all of its connections into Clear Lake. Grain, coal, lumber, lime and cement are being shipped into Clear Lake in large quantities by this line; in fact, it is getting at least three-quarters of the business. This is well situated for stock shipping, on account of the ranches situated in this vicinity, the 4,000 acre ranch of Mr. Linden having given considerable business to the line already.

The city of Athens, Ala., will contract at an early date for the erection of an electric light plant, to be run in connection with the city waterworks.

A Decade of Electric Railway Development.[1]

By William J. Clark.

An eminent writer on railway subjects has substantially said that a railway is a "machine for the manufacture of transportation."

Were we asked, in a single instance, to cover the full meaning of this paper's title, we might respond with such a quotation, for, most certainly, viewing the true objects of a transportation company in the broadest manner possible, it is to exemplify this theory, and probably in the whole history of transportation no class of managers has done so much to create travel, rather than to merely take care of what may seem to be the existing demand, as have those of American street railways since they have had at their command that most flexible of transportation agents—electricity. In carrying out this broad-gauged policy they have benefited communities and the general public to an extent that is beyond any estimate, and while it is true certain benefits have accrued to stockholders, these do not begin to aggregate the blessings that electric traction has conferred upon those who are frequently the most anxious to condemn it as a motive power. It is with this phase of the situation that this paper will deal, rather than elaborating upon the conquests that have been achieved in the technical and engineering branch.

Going back to the commencement of the present decade, there was in your state but one electric line, some three miles in length, and this particular road, although it enjoys the distinction of being the nucleus around which you have built an extensive and model electric railway system, you will concede was experimental in its character, and that those other small lines which were contemplated at the same period in New York state were of similar experimental character, so that, commercially, electric traction could not be said to have existed in the Empire state 10 years ago; at the present moment there are slightly over 6,000 motor cars in daily use within the territory covered by your association. But to grasp the extent and rapidity of electric railway development the following comparative statement, covering all the street railways in the United States, will serve best as an illustration:

From such statement should be noted not only the tremendous increase in percentage of electric traction to the total, approximately 15,000 per cent., but also the fact that the street railway mileage of the United States has increased over 156 per cent. during the period given. During the same interval the mileage of American steam railways has increased but 31 per cent. This fact in itself would seem to demonstrate that the American street railway men have grasped the possibilities of building up transportation in a more thorough manner than have their brethren of the steam railway fraternity, as well as demonstrating the theory that we have advanced. But for a more immediate illustration of the comparative growth, as well as some other startling facts, let us come nearer home and introduce a comparative statement compiled from the reports of the railroad commissioners of the state of New York for the years 1887 and 1896, covering street railways, surface steam railways and steam elevated systems:

It may be said that all of the wonderful progress above shown by the street railway interests cannot be directly attributable to electricity, as the introduction of cable in New York city is, to a certain extent, responsible for such progress, yet as the effect of the cable traction on our general proposition is so similar to that of electricity, and as New York is so fast becoming an electric traction city, it is considered unnecessary to go into the refinement of sub-division of mechanical traction methods in their effect, for both tend to demonstrate the theory which we have advanced, and show that as great benefits have been conferred upon the community served as can be done consistently with the financial investments in the corporations, and, unquestionably, to a certain extent, show also that in development which discounts the future, resulting in the public benefits referred to, the interests of stockholders may not have been as thoroughly promoted as if a less liberal policy had been pursued. Yet, some of the figures, unless further explained, might be grasped by those who advocate municipal ownership, reduced rates of fare and additional burdens upon street railway corporations, as demonstrating the theories of increased earnings, reduced operating expenses and other things which they consider sufficient reasons for advocating practically the confiscation of vested rights of the greatest benefactors, in a corporate way, communities have ever had. True, street railway earnings have increased and operating expenses have decreased, and many other advantages have come to the street railway companies through the introduction of electricity, but for every dollar of actual net return which the investor in street railway securities has received in the Empire state, we do not hesitate to say that the municipalities and the general public have received at least $10 direct benefit and that the general public has thus profited far more greatly from the advantages of rapid transit than have the investors who produced it.

Let us consider some of the figures quoted: In 1896 the operating street railways of New York state paid $1,164,820.40 in direct taxes—a good-sized percentage in itself on gross receipts, as will be noted. This, let it be remembered, does not include certain additional amounts paid by the holders of securities of lessor and other companies, or certain percentage contributions, which, if calculated together, would compare favorably in amount with the demands for percentage payments made by some of the loudest advocates of such theories. A little calculation will also show that the street railway companies maintain about 9,000,000 square yards of street surface or paving, the practical equivalent of maintaining a street 250 miles long; yet, as is well known, with the now rare exception of horse railways, the street railways of New York state do not wear the surface of the street at all, but their tracks unquestionably save much wear from vehicle travel, as compared to the ordinary roadway, which must be maintained by the municipality. Remember, these burdens are imposed for the privilege of running the "poor man's carriage."

From a calculation based upon the census returns of 1890, the average tax rates of the various cities in New York state, the owner of an ordinary carriage or vehicle pays, proportionately, only about one-sixth as much for his privilege of going where he will with the same and wearing out the pavements at pleasure.

One of the results for which I presume electricity must be to a certain extent held responsible, owing to the expectation of greater returns and other excuses made by municipal officials for unreasonable assessment, is inequality of taxation. To illustrate this point, we interject here a somewhat surprising calculation compiled from the railroad commissioners' report for 1896, which would seem to demonstrate that valuation of property, earnings, passengers carried, car-miles run, or no other intelligent basis of assessment of taxation on street railways in this state has been followed; and that certain hardships have resulted, is, we think, clearly apparent.

But to return to our analysis of the general statistics given, it is to be regretted that the data is not attainable which would show the exact increases in valuations of real estate caused directly by the extensions of street railway lines during the last 10 years. We believe, however, that such increases in New York state amount to $300,000,000, a direct gain to the holders of abutting and adjacent property and a direct benefit to the state and municipalities by increasing the amount of taxable property. This, it will be noted, is more than the entire investment in street railway properties.

Let us make another calculation: It is certainly reasonable to suppose that the extensions of street railway lines and faster service obtained, during the past 10 years, saves to each passenger at least 10 minutes of time. This means annually to the citizens of New York state a saving of 112,083,127 hours. Consider such time to be worth only an average of as low as 10 cents per hour, and we have a saving of $11,208,312, or nearly double the net earnings from the operation on all the street railways of the state.

Looking over our figures, we might be met with that oft-repeated statement that street railways have been over-capitalized. To this charge we cannot but reply that the promoters of some of the street railways have not been entirely guiltless of the sin of over-capitalization to a certain extent, yet far less than is ordinarily supposed. We believe, however, that the aggregate amount of all such illegitimate financiering in connection with the street railways of New York state, since the advent of mechanical traction, is not so great as the unintelligent and wasteful expenditure of public funds in one or two large cities of the United States, for a fraction of this period, and we cheerfully invite the advocates of municipal ownership to devote some study to this feature. Where the money represented by the present investments has gone is in the legitimate purchase of underlying companies, or companies antedating mechanical traction, and in expensive construction and equipment, which could be duplicated to-day at a much smaller figure. In the early days of electric traction, when most of the construction and equipment were done in this state, girder rails cost more than double their present figure; electric car equipments from 250 to 400 per cent. more; car bodies from 25 to 35 per cent. more; power station equipment from 100 to 300 per cent. more. That prices have depreciated is not the fault of the railway investors and managers, and surely does not affect the legitimacy of their investments. The public should feel grateful for the additional incentive which the present low prices now give the railway corporations for offering them still better transportation facilities. Somewhat on the same lines, we should refer to the mistaken impression generally prevailing, even among those who are supposed to have some knowledge of the subject, as regards the entire cost of thorough electric railway construction and equipment. As illustrating this, a few months since I was called upon to prepare a careful estimate on the cost of duplicating an extensive street railway system in the West, where the city engineer had stated that approximately $3,500,000 would rebuild the system in accordance with the most approved ideas. The engineer referred to was re-

1. Read before the New York State Street Railway association at Niagara Falls, September 14, 1897.

General Comparative Statement of Street Railways in the United States January 1, 1888, and January 1, 1897.

	Jan. 1, '88.	Jan. 1, '97.
Total number of operating companies	615	806
Number of street railway systems operated by horses	566	167
Number of street railway systems operated by cable	18	38
Number of street railway systems operated by steam dummies (not including elevated)	35	33
Number of street railway systems operated by electricity	21	698
Mileage of horse-car track	5,474	1,010
Mileage of cable track	217	515
Mileage of steam dummy track (not including elevated)	216	145
Mileage of electric track	86	13,580
Total mileage of street car tracks	5,993	15,250
Number of horse cars	21,736	3,654
Number of cable cars: grip, 860; trail, 1,917	2,777	5,957
Number of steam dummies and cars: dummies, 165; cars, 253	423	318
Number of electric motor cars, 166; trail cars, 6	172	37,097
Total number of street cars, all descriptions	25,108	47,036
Per cent. horse car track to total mileage	.914	.066
Per cent. cable track to total mileage	.036	.034
Per cent. dummy track to total mileage	.036	.009
Per cent. electric track to total mileage	.014	.891
Per cent horse cars to total number	.866	.078
Per cent. cable cars to total number	.111	.127
Per cent. dummy cars to total number	.017	.007
Per cent. electric cars to total number	.006	.788
Average length horse car systems	9 67 mi.	6.05 mi.
Average length cable systems	12 06 mi	13.55 mi.
Average length dummy systems	6.17 mi.	4.39 mi.
Average length electric systems	4.09 mi.	18.02 mi.

Taxation Statistics, Street Railways in New York State, 1896.

	Taxes.	Per Mile Track	Per Car Mile.	Per Passenger.
Case one	$17,205	$880.00	.....	.....
Case two	1,381	283.00	$ 00768	$.00228
Case three	54,537	1,280.00	.01485	.00377
Case four	1,082	102.50	.00283	.00110
Case five	3,180	113.50	.00379	.00094
Case six	22,055	1,175.00	.00947	.00164
Case seven	289,723	1,442.00	.01347	.00272
Case eight	24,336	540.00	.00717	.00157
Case nine	80,525	1,197.00	.01285	.00235
Case ten	1,189	79.50	.00564	.00025
Case eleven	1,560	52.00	.00251	.00236
Case twelve	157	52 50	.00210	.00185
Case thirteen	648	199.50	.00304	.00083
Case fourteen	170	39.80	.....	.00032
Case fifteen	23.399	935.00	.01132	.00355
Case sixteen	187	31.70	.00240	.00067
Case seventeen	600	57.20	.00283	.00085
Case eighteen	24,932	312.00	.00910	.00181
Case nineteen	1,430	387.00	.01965	.00613
Case twenty	2,505	224.00	.00495	.00184
Case twenty one	1,033	243.50	.00490	.00238
Case twenty-two	1,475	83.20	.00354	.00119
Case twenty-three	1,450	162.00	.....	.00139
Case twenty-four	1,151	192.00	.....	.00131
Case twenty-five	602	140 00	.00635	.00191
Case twenty-six	600	118.50	.00339	.00227
Case twenty-seven	1,257	525.00	.....	.00402
Case twenty-eight	1,498	214.00	.00485	.00097
Case twenty-nine	4,505	214.50	.00718	.00182
Case thirty	1,640	577.00	.00875	.00195
Case thirty-one	427,699	8,550.00	.01820	.00245
Case thirty-two	1,385	103.00	.00335	.00112
Case thirty-three	16 273	266.00	.00352	.00114
Case thirty-four	3,271	593.00	.00779	.00189
Case thirty-five	5,428	331.00	.01220	.00369
Case thirty-six	1,736	272.00	.01480	.00426
Case thirty-seven	860	147.50	.....	.00275
Case thirty-eight	2,567	153 00	.00467	.00143
Case thirty-nine	48 814	558.00	.00975	.00282
Case forty	3.365	218.00	.02850	.00590
Case forty-one	1,497	308.00	.02140	.00228
Case forty-two	680	300.00	.....	.00412
Case forty-three	329	74.50	.00624	.00306
Case forty-four	778	104 00	.00316	.00312
Case forty-five	6,777	214.00	.00590	.00172
Case forty-six	93.519	3,300.00	.00740	.00149
Case forty-seven	1,689	283.00	.01510	.01515
Case forty-eight	148	54.00	.00274	.00132
Case forty-nine	12,769	505.00	.00575	.00127
Case fifty	18,964	557.00	.00764	.00195
Case fifty-one	3,002	375.00	.00363	.00085
Case fifty-two	688	222.00	.00337	.00122
Case fifty-three	587	90.50	.00179	.00105
Case fifty-four	3 911	236.00	.00518	.00157
Case fifty-five	1,914	212 00	.00449	.00147
Case fifty-six	2,661	295.00	.00865	.00215
Case fifty-seven	814	74.00	.00590	.00140

Comparative Statement of Average Wages and Services Required. Street Railway Employes of New York State.

	1887.		1896.	
	Wages per hour.	Hours per day.	Wages per hour.	Hours per day.
Conductors	$.141	11.79	$.159	10.62
Drivers	.141	11.97	.183	10.40
Starters	.184	11.14	.182	10.90
Watchmen	.142	14.09	.145	11.22
Switchmen	.142	10.68	.143	10.44
Roadmen	.158	10.29	.153	10.20
Hostlers	.131	11 52	.145	10.57
Blacksmiths	.252	10.11	.....	.....
Carpenters	.218	10.14	.200	10.00
Painters	.241	10.22	.200	10.00
Harnessmakers	.225	10.00	.....	.....
Inspectors	.217	10.70	.235	9.50
Car cleaners	.148	10.50	.....	.....
Tow boys	.109	12.31	.....	.....
Trackmen	.172	10.50	.....	.....
Repairmen	.264	10.00	.....	.....
Foremen	.215	11.50	.200	10 00
Engineers	.220	11.33	.243	10.37
Motormen	.095	14.00	.161	10.72
Machinists	.....	.....	.222	9.98
Mechanics	.....	.....	.219	9.95
Linemen	.....	.....	.193	10.19
Firemen	.....	.....	.159	10.81
Electricians	.....	.....	.227	10.15
Transfer agents	.....	.....	.200	10 00

quested to answer a long list of questions, which practically constituted specifications, as to his ideas on construction and equipment, and a most careful calculation was made by myself and others in accordance with his ideas, the result being that at least $7,500,000 was found to be necessary to duplicate such a system in accordance with the specifications of the engineer. The opponents of the present methods of street railway ownership and operation would probably state that the rapid extension of street railway lines would not have been made had not additional returns been expected by the investors, and that, to a certain extent at least, the results which we have quoted would verify this statement. Yet, far more apparent than this is the fact that with the extension of lines have come the transfer system and lengthened routes, so that the average nickel will now carry a passenger three times as far on the street railways of New York as it would have done 10 years ago—another illustration of the benefits which the public has derived; and it is safe to say we would hear no comments on the fact that the rates per passenger had been reduced during the past 10 years. Let us now for a moment consider what might have been the result had the street railway management of New York state, as a whole, been less progressive than it has. All of the large systems are practically the outgrowths of old horse-car companies, which were generally laid on the principal thoroughfares, affording a large short-haulage travel, and which could now be handled in a most profitable way by mechanical traction methods at an average rate much less than upon systems which have extended their lines, so that a large proportion of their mileage is suburban or through comparatively unprofitable territory. Let us cite a case from actual records, showing what the effect would have been. A certain street railway system in a large city, operating about 30 miles of track by horse traction in 1887, equipped its lines with mechanical traction, but has never extended the same. It is well managed and gives magnificent service, but cannot be said to have conferred the benefits upon the community which other systems have that have followed the general programme of extension. The following shows the approximate results from its operation in 1887 and 1896:

	1887.	1896.
Gross receipts	$1,346,550.00	$2,680,448.00
Operating expenses	974,794.00	1,448,157.00
Per cent. operating expenses to gross receipts	72.5	54.2
Fixed charges	294,326.00	316,007.00
Net income	77,428.00	886,284.00
Dividends	60,000.00	800,000.00

We think no comment is necessary to illustrate this company's prosperity. Nor does it need any elaborate argument to show, in this particular case at least, better results could not have been obtained had extensions been built.

We have heard it claimed that the employes of the street railway companies have not profited as they should through the advanced methods adopted by their companies. A glance at the statistics we have quoted illustrates how their number has increased, and the following statement will, we think, demonstrate that the condition of the employes of no other large industry in this country has shown as comparatively great improvement in 10 years as has that of the street railway employe in the Empire state.

We regret that time and space will not permit us to make an elaborate comparison of the wages paid street railway employes here with those prevailing abroad, or to demonstrate at length that electric traction increases the labor account, although it produces economy in other directions. We would note, however, that according to the last report of the Glasgow tramways—the model horse-railway system of the world and the ideal of municipal ownership—the total wages aggregate but 43 per cent. of the operating expenses, while on that model of electric street railways, the Buffalo system, as shown by its report for 1896, over 77 per cent. of the entire operating expense is paid to labor, while this percentage holds practically good on all the street railways of the state operated by mechanical traction. This analyzed would mean that out of approximately $29,000,000 gross receipts received by the street railways of the state, $13,000,000 is paid directly to employes as wages, while, of course, a goodly share of the remainder of the operating expense goes indirectly to labor in the production of materials required in connection with operation and replacement. Against this, the stockholders of the operating companies get but, approximately, $3,400,000 annually in dividends for their large investment.

Now as to the most serious of all offenses that have been charged to mechanical traction, viz., accidents: The daily press is constantly filled with references to the "deadly trolley," with occasional remarks concerning Mr. Vreeland's cars of "Juggernaut," but what are the real facts concerning this very serious matter, and what are the comparative results between the present and the past on street railways in this state, and how does the annual result compare on street and steam railways? According to the railroad commissioners' report of 1896, there were killed, on the street railways of New York state, 13 passengers, seven employes, and 51 others, making a total of 71. This represents one for each 1,807,316 car-miles run, or one for each 9,383,258 passengers carried. Against this number the surface steam railways killed five passengers, 211 employes and 544 others, or a total of 760. This represents one for each 241,950 train-miles run, or one for each 235,941 passengers carried. So it is safe to say on fatalities that our steam railway friends are producing the same in the proportion of about eight to one, as against the street railways. In the same year the street railways injured 197 passengers, 35 employes and 157 others, or a total of 389. This represents one for each 329,875 car-miles run, or one for each 1,728,788 passengers carried. During the same period the steam railways injured 174 passengers, 2,142 employes and 592 others, or a total of 2,908, running for each 63,233 train-miles, or carrying 61,663. The total killed and injured on street railways was 462, or one for each 277,752 car-miles run, or one for each 1,442,016 passengers carried. The total killed and injured on the steam railways amounted to 3,668, or one for each 50,131 train-miles, or one for each 46,886 passengers carried. From this comparison it will be seen that if the daily press devoted as much space comparatively to steam railway accidents as to those on street railways, they would have room for nothing else in their columns, and might require daily Sunday editions. To listen to some of the comments on street railway accidents, it would be supposed that no such thing had ever been heard of until the introduction of mechanical traction, yet in 1887 the street railways of New York killed one person for each 9,983,646 passengers carried; almost the same average as the present, as shown above. They injured one person for each 1,398,487 passengers carried, or proportionately 25 per cent. more than in 1896. This, we think, thoroughly demonstrates that mechanical traction is far safer than the horse car in every way. But another surprise: While, as shown, the percentage of accidents has been decreased, the natural inference would be that this improvement had occurred in connection with the passengers or employes, and that with increased speed must come greater danger to those upon the streets. Strange to say, however, the proportion of accidents between 1887 and 1896 to this class is 33 1-3 per cent. less. It should be remembered in this connection that the average speed of cars on the street railways of New York state has more than doubled during the past 10 years.

The accumulation of statistics quoted has lengthened this paper far beyond my original expectations, until I fear it has become burdensome, and at the same time I may be accused of treating almost entirely subjects which would only indirectly come under the title, yet you are all practically as familiar as I am with the technical and engineering side of electric traction development, so I trust I may be pardoned for not dilating upon the same, and will close with the brief prophecy that another decade will find electric traction occupying the same position as regards operation of heavy standard railways that it now does toward the street railway.

Comparative General Statistics on All Operating Railway Companies, New York State, 1887–1896.

	Surface Steam Roads.				Elevated Steam Roads.				Street Railways.			
	1887.	1896.	Inc. or Dec.	Per cent. Inc. or Dec.	1887.	1896.	Inc. or Dec.	Per cent. Inc. or Dec.	1887.	1896.	Inc. or Dec.	Per cent. Inc. or Dec.
Gross earnings, freight and passenger traffic	$143,724,490.62	$210,089,592.75	$66,365,102 13	46.09	$8,691,439 49	$11,896,461.45	$3,205,021.96	36.87	$17,966,518.31	$28,808,898.84	$10,842,380 53	60.38
Operating expense, freight and passenger traffic	92,439,974.60	146,063 417.17	53,523,442.57	57.98	4,962,148.96	7,154,581.22	2,192,332.26	44.20	13,291,855.32	17,848,759.27	4,556,903.95	34.31
Net earnings from operation	51,284,516.02	64,026,174.98	12,741,658.96	24.87	3,729,290 53	4,741,880.23	1,012,589.70	27.18	4,674,662.99	10,960,139.57	6,285,486.58	134.6
Income from other sources	5,453,671.31	7,132,210.88	1,673,539.57	30.80	87,659.06	247,119.87	159,460.81	182.00	320,933.38	1,428,192.86	1,108,259.48	346.4
Gross income from all sources	56,738,187.33	71,158,385.86	14,420,198.53	25.90	3,816,949.59	4,989,000.10	1,172,050 51	30.72	4,996,596.37	12,388,332.43	7,391,736.06	148.1
Interest	17,469,522.21	23,052,019.30	5,582,497.09	32.00	1,781,442.29	3,104,125.36	1,322,683.07	74.24	1,565,711.62	3,351,770.31	1,786,058.69	114.15
Rentals of leased lines	14,702,117.28	20,710,892.89	6,008,775.61	40.80	20,000.00	68,225.00	48,225.00	241.1	342,318.00	3,833,211.91	3,490 893 91	1,020.0
Taxes	5,018,907.21	7,781,389.32	2,762,482.11	55.01	478,294.83	895,830.31	417,535.48	87.40	829,192.49	1,164,820.40	335,627.91	40.4
Miscellaneous deductions from gross income	1,039,697.49	1,390,260.29	350,562.80	33.72					54,747.97	170,993.42	116,245 45	212.6
Total deductions from gross income	38,230,244.19	52,934,561.80	14,704,317.61	52 20	2,279,737 12	4,068,180.67	1,788,443.55	78.53	2,791,970.08	8,520,796.04	5,728,825 96	205.3
Net income from all sources	18,507,943.14	18,223,824.06	284,119.08	1.53 Dec	1,537,212.47	920,819.43	616,393 04	40.1 Dec	2,203,626.29	3,867,536.39	1,663,910.10	75.65
Dividends	10,207,885.50	14,557,454.00	4,349,568.50	42.12	1,560,000.00	1,800,000 00	240,000.00	15.38	1,415,397.50	3,379,953.95	1,964,556.45	113.95
Miscellaneous payments from net income	15,654.04	102,554.13	86,900.00	555.10					36,128.76	8,503.73	27,625.03	76.7 Dec
Surplus	8,284,403.60	3,563,815.93	4,720,587.67	87.00 Dec	22,787 53	879,180.57	856,393.04	376.5 Dec	752,100.03	479,078.71	273,021.32	36.33 Dec
Percentage operating expenses to gross receipts	64.42	69.52	5 1	7 92	57.08	60.14	3.06	5.36	73.98	61.96	12.02	16.26 Dec
Percentage net income to capital stock	3.5	2.43	1.07	30.6 Dec	4.79	1.91	2.88	60.13 Dec	6.89	3.61	3.28	47.65 Dec
Percentage dividends to capital stock	2.19	2.49	.3	13.7	4.9	3.73	1.17	23.90 Dec	4.5	5 08	.58	12.89
Percentage gross income to cost, road and equipment	4.81	5.39	5.8	12 07	7.96	5 02	2.94	36.93 Dec	8.58	4.8	3.78	44.05 Dec
Total passengers carried	94,272,116	179,315,449	83,043,333	90.25	172,358,082	235,330,148	62,972,066	36.53	361,543 930	672,498,760	310,954,830	86.1
Passenger earnings per mile traveled*	2.36 cts.	2.22 cts.	.14 ct.	5.94 Dec	5.04 cts.	4.05 cts.	.01 ct.	.2	4.97 cts.	4.28 cts.	.69 ct.	13.90 Dec
Passenger expense per mile traveled*	1.51 cts.	1.64 cts.	.13 ct.	8.61	2.88 cts.	3.04 cts.	.16 ct.	5 56	3.68 cts.	2.65 cts.	1.03 cts.	28.00 Dec
Passenger profits per mile traveled*	.85 ct.	.58 ct.	27 ct.	31.73 Dec	2.16 cts.	2.01 cts.	.15 ct.	6.94 Dec	1.29 cts.	1.63 cts.	34 ct.	26.35
Miles of track in New York state	12,248.44	14,401.25	2,152 81	17.57	109.81	167.743	57.933	52.75	908.91	1,736.99	828.08	91.15
Gross earnings from operation per mile of road operated	$12,050 03	$13,787 21	$1,697.18	14.04	$79,140,69	$70,921.73	$8,218.96	10.38 Dec	$19,765 12	$16,591.25	$3,173.87	18.07 Dec
Operating expense per mile of road operated	7,776.00	9,585 47	1,809 47	23.32	45,103 60	42 652.80	2,450.80	5.45 Dec	14,622 49	10,275.60	4,346.80	29.68 Dec
Net earnings from operation per mile of road operated	4,314.03	4,201.74	112.29	2.61 Dec	34,037.09	28,268.93	5,768 16	16.94 Dec	5,142.63	6,325.85	1,183.02	23.05
Average number of employes for year	102,634	146,987	44,353	43.22	5,136	7,120	1,984	38.66	13,873	23,952	10,079	72.70
Combined net income of operating companies and dividends of leased companies, constituting entire net income of all roads	$22,122,931.74	$22,337,604.59	$214,662.85	.97	$1,537,212 47	$920,819 43	$616,393.04	40.1 Dec	$2,226 974.29	$5,774,229.72	$3 547,255.43	159.3

*On street and elevated railways these figures are given "per passenger."

Railway Telegraphers in Trouble.

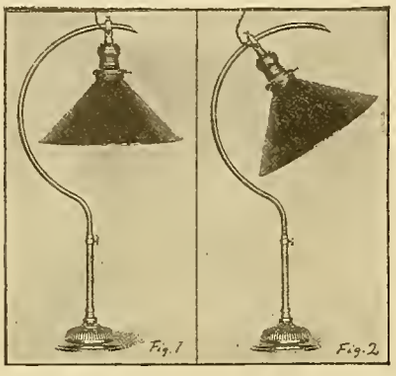
W. V. Powell, grand chief, and H. B. Perham, grand secretary of the Order of Railroad Telegraphers of North America, were taken before United States Commissioner Howe at Peoria, Ill., September 27th, to answer a charge of violating the alien labor law by employing a Canadian clerk in the offices of the order. They waived examination and gave bail in the sum of $1,000 each for their appearance before the United States grand jury.

The action against the officers is brought by a former employe in the grand offices, who lost his position when the Canadian clerk was employed. The complainant claims that there was an ante-election agreement between the grand officers whereby the Canadian was to receive employment in the offices for services rendered the officers in the campaign. The officers deny this. They say a large percentage of the membership of the brotherhood is in Canada, and that Canada is entitled to some recognition in the headquarters.

The old plant in the city hall, Chicago, broke down last week, an engine cylinder head blowing out, and the second engine breaking down when the entire load was thrown upon it. The building was left in complete darkness for a time. Then an attempt to use gas resulted in an explosion.

Faries Universal Lamp Holders.

It is safe to say that there are some dealers in supplies and other purchasers of high-class electrical specialties who do not fully realize the variety of the line of goods made by the Faries Manufacturing company of Decatur, Ill. Incandescent lamp brackets, detachable arms of all conceivable shapes and patterns are illustrated in this company's very handsome and complete catalogue; and the accompanying cuts give but an inadequate idea of the artistic and beautiful design of this company's various lamp holders. The Faries simple one-arm lamp holder is very useful for store-window service, as it can easily be swung so as to carry the lamp well out of the way. Then there is the



FIGS. 1 AND 2. FARIES UNIVERSAL LAMP HOLDERS.

long-arm jointed bracket for factory use, and also the exceedingly artistic design of "long-reach" bracket for dentists.

This "long-reach" bracket has met with ready sale, especially through a dental supply house in Pittsburg. Figs. 1 and 2 show an adjustable lamp support for table or desk use, either in the office, store or home. It has a heavy base, and a study of the curved standard supporting the lamp shade and lamp reveals the extent of the angle to which the lamp held by this stand may be adjusted. The Faries company also manufactures what might be aptly termed a line of "universally adjustable" chandeliers, which have arms that may be adjusted into almost any position. These chandeliers can be furnished with different designs of arms or branches to support different styles of lamp shades.

The company has also recently gotten out a new device in the shape of a detachable arm which carries a lamp and works in a support that may be attached to, say, a wall. As many as three or four supports may be put at convenient places on the wall and the lamp quickly changed from one to another, thus making the lamp in a measure portable.

The base of Fig. 3 is very heavy and strong, and has a 1¼ inch standard with a 1 1-16 inch iron pipe inside (these are all outside measurements), making these fixtures very strong and rigid. With the cut in view it seems hardly necessary to say that the outer arms can be thrown up or down to any degree. They also have free motion sidewise to nine-tenths of a circle. Besides this, the inner arm, to which the outer arms are attached, has a horizontal swing three-fourths around or more. The lamp is placed in the desired position and the shade slipped around so as to shield the eyes, and by its reflecting surface throw the light strongly onto the work.

It may be said, however, that to appreciate fully the various valuable features embodied in the Faries specialties one must first study the catalogue and then inspect the goods, as the appearance of the ornamental designs and artistic finish of these fixtures only becomes evident after personal inspection.

New Chicago Supply House.

The opening in Chicago of a new electrical supply house at the present time can be taken as a sign indicative of the strong belief and conviction that prosperous times are at hand. Last week a new sign made its appearance at 236½ East Madison street, and the Reliable Electrical Supply company opened its doors for business.

The proprietors of this new company are J. Harris and Otto Reiman. Mr. Harris is a capitalist well known in Chicago real estate circles, and his unquestioned business ability will contribute largely as a factor in the success of the business. Mr. Harris will devote himself almost exclusively to the finances of the company for which his experience eminently fits him.

Otto Reiman hardly needs an introduction. For years he has been the financial and credit man of the Metropolitan Electric company of Chicago. His knowledge of the general electrical supply business will stand him in good stead in his new venture. Mr. Reiman made a good reputation for himself in the handling of the old Metropolitan company's financial matters, and his long experience, too, with the credits of that company should contribute to his success in the management of the new enterprise.

Offices and Salesroom.
NEW CHICAGO SUPPLY HOUSE.

Exterior View.

J. Harris.
NEW CHICAGO SUPPLY HOUSE.

The Reliable Electrical Supply company makes its start on a conservative basis, and it has come to stay. It is the idea of the company to have the institution follow in the wake of its trade, so to speak, rather than the trade build up to the institution. Messrs. Harris and Reiman intend to carry on their business at a minimum expense consistent with the furnishing of the very best goods on the market by the promptest sort of shipment. They intend to make their stock of the choicest and have it complete in every respect in so far as the very best line of specialties is concerned. The main idea underlying their policy is large sales at small profits, and their conservative start in the matter of expense is indicative that this will be adhered to. It is the purpose of the Reliable company to hold its trade by adhering strictly to the prompt and complete filling of all orders at the closest prices possible. In a word, goods are to be shipped the same day they are ordered. Already C. W. N. Money, a well-known electrical salesman, has been engaged to travel for the company, and Mr. Money is now on the road.

Roth Multipolar Dynamo.

The type of multipolar dynamos and motors made by Roth Bros. & Co. of 30 Market street, Chicago, is shown by the picture. Great care has been taken to produce a reliable machine fitted to stand the most critical inspection. All wearing parts are interchangeable. As dynamos or motors, the machines are wound for 110, 220 and 500 volts. When built for lighting or general current distribution, they are compounded and are made self-regulating at constant speed.

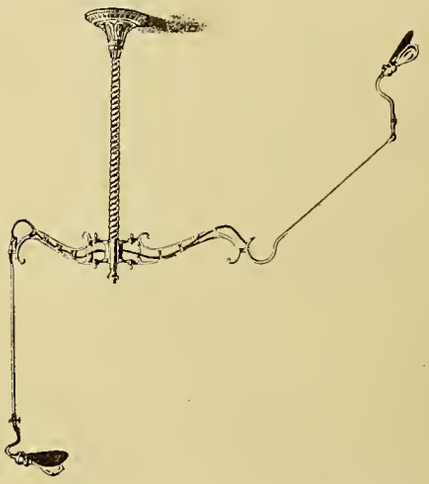


FIG. 3. FARIES UNIVERSAL LAMP HOLDER.

The armature is of the hollow drum type, the core being built on a cast-iron hollow cylinder easily removable from the shaft. The core disks, varnished for insulation before being put together, are held between two solid cast-iron end plates, the clamping bolts passing through the inner space of the hollow drum. This method of construction avoids holes through the core disks, thus giving a uniform magnetic path in the armature. The armature coils are wound on a form, taped with silk tape, varnished and baked before being placed on the core. The parallel grouping of armature construction is employed, which, in connection with a special system of commutator connections, greatly facilitates the repair of the armature. In case a coil has to be removed, this may be done by simply loosening the two armature connectors of which the coils form a part.

Otto Reiman.

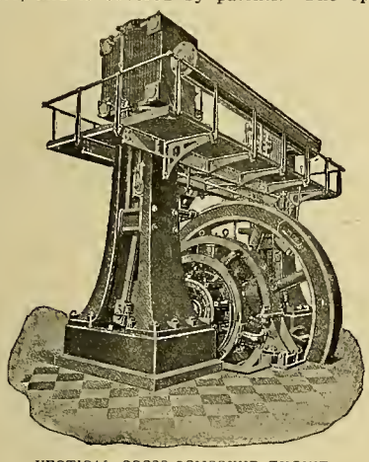
The commutator has a liberal collecting surface as well as wearing stock and a large number of sections. Carbon brushes are used on all machines of 110 volts and over. The brush-holders are of the tangential reacting type, the commutator surface moving in a direction opposite to the pressure of the springs. Each brush-holder contains a number of square carbons, each pressed against the commutator by a spring. The tension of the springs may be adjusted and the carbons removed while the machine is running. These brush-holders are among the simplest and most efficient yet devised.

The field frame is of the radial external-pole type, which form has met with general approval during late years. The yoke is broad and entirely

protects the field coils. The field cores are annealed wrought-iron with circular section, which combines a maximum economy in the work of winding and the material of the field coils. The bearings are self-oiling, self-aligning, and provided with oil gauge and cock.

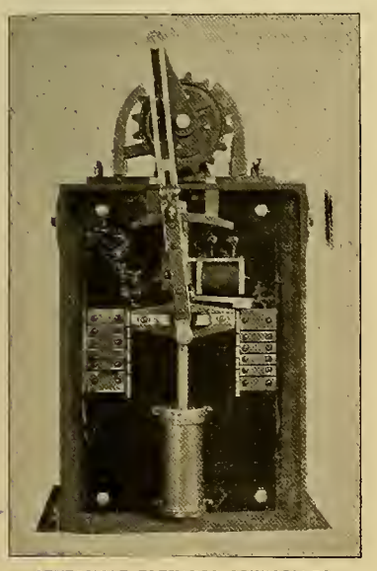
Reversible Elevator Controller.

To control the movements of electric elevators, the American Rheostat company of Milwaukee has devised the switch-and-rheostat mechanism shown by the cut. The elevator machine is connected with the controlling switch of the controller either by link chain, or shaft, or gears, as may be desired. The direction in which the switch is thrown governs the direction in which the car moves, the switch being both reversing and a cut-out switch. This is practically sparkless in its operation, it being constructed so as to fully receive the discharge of the fields. This is an important feature, as will be readily understood by those handling such controllers, and is covered by patents. The operator



VERTICAL CROSS-COMPOUND ENGINE.

can bring the rheostat arm to its central position and retain the brush in any position on the contacts he may desire, thereby placing in his power the control of the speed of the car, but he cannot carry the brush over the contacts to cut out the resistance; this is done automatically, and a controlling magnet prevents excessive current from passing the armature. As soon as the amount of current is reached for which it is adjusted it prevents the further movement of the brush. A latch in the connecting rod and operating on the quadrant prevents the rheostat brush from passing over the contacts until the operating mechanism has been thrown sufficiently to insure the positive closing of



REVERSIBLE ELEVATOR CONTROLLER

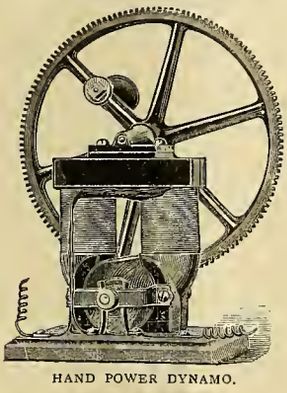
the cut-out switch in either direction. The resistance is mounted on porcelain, and is of ample capacity to prevent the possibility of burning out. No pains have been spared to make a first-class controller in every particular, both as to construction and operation.

Hand Power Dynamo.

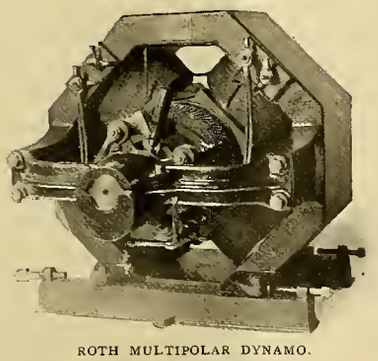
The hand power dynamo shown by the cut is made by the Carlisle & Finch company of Cincinnati, which manufactures a variety of electrical novelties and toys of original design, including several types of electric railways adapted for use as show-window attractions or for amusement or experiment. It is simply a dynamo-electric machine of miniature size adapted to be operated by hand. The handle is fastened to a large gear-wheel which meshes into a pinion on the armature shaft. The weight of this dynamo, packed for shipment, is 16½ pounds. The machine can also be furnished with pulley for belt driving and then weighs two pounds less. It is very compact and gives a powerful current for a machine of its size. It is mounted on a hardwood base, has a tool-steel shaft and babbitted bearings and is neatly painted. The manufacturer states that this little dynamo will light a 10 candle power, 10 volt incandescent lamp, furnish current to run several electrical toys at once, or perform almost any electrical experiment. Among other things it will decompose water, electroplate metals, fire blasting fuses, etc. When used with any of the toy railways it makes an ideal miniature power plant. There are no batteries to be considered; the power is ever ready, and the speed of the car can be varied by changing the speed of the dynamo.

Volo Microphone.

The illustration shows the Volo microphone made by William M. Snyder of 216 Mill street, Germantown, Philadelphia. Mr. Snyder puts forth this transmitter as an article of real merit, and he says that where one is used more will be demanded. The Volo microphone, it is claimed, requires a smaller battery than is usually required for trans-



HAND POWER DYNAMO.



ROTH MULTIPOLAR DYNAMO.

VOLO MICROPHONE.

mitting speech; at the same time it gives noticeably loud, clear and natural tones. Indeed, it is said to be entirely without the thick sounds like words running together or the harsh, grating sounds sometimes heard. Talking through it is said to be a positive pleasure to speaker and listener alike, the effect being as though the first were speaking in an ordinary tone close to the ear of the other. This transmitter is claimed to be equally reliable for interior or long-distance work. It will not pack or get out of order, it is said, and, on the whole, is confidently presented to the users of telephone apparatus as an honest combination of efficiency, strength and beauty.

An old advertising scheme has been adapted to electrical use by an English electrical paper. The proprietors offer the sum of 10 pounds to the next of kin of any person who may be killed by accident through electric shock in the United Kingdom, provided that a copy of the current issue of the paper be found upon the deceased at the time of the accident.

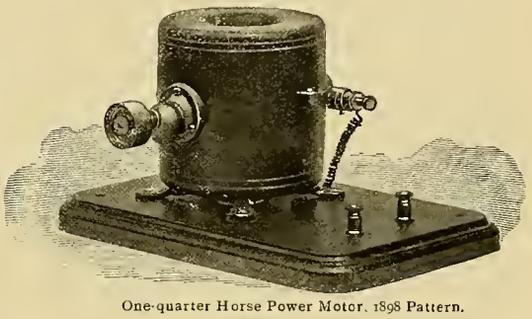
Vertical Cross-compound Engine.

The cut shows a vertical cross-compound engine erected at the works of the Western Electric company, at Chicago, by the Philadelphia Engineering Works. This engine drives a 400 kilowatt Western Electric generator, from which power is distributed throughout the building.

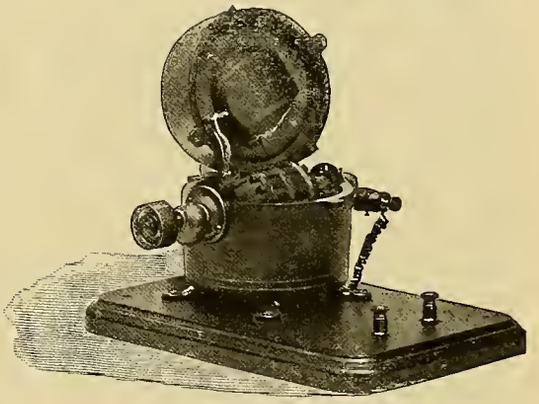
The principal dimensions are as follows: Diameter of high-pressure steam cylinder, 22 inches; diameter low-pressure cylinder, 34 inches; common stroke, 36 inches; length of main journal, 24 inches; diameter of main journal, 12 inches; diameter main shaft at wheel seat and generator, 16 inches; diameter of crank pin, six inches; length of crank pin, seven inches; connecting rod, length, seven feet six inches; connecting rod, diameter in center, 5 1-8 inches; piston rods, diameter four inches; surface of each of the four cross-head slippers, 180 square inches; throttle valve diameter, eight inches; fly-wheel diameter, six inches; weight of fly-wheel, 50,000 pounds.

The engine runs at the rate of 100 revolutions per minute, with a boiler steam-gauge pressure of 130 pounds. Its usual load is about 700 horse power. It will be observed that the dimensions of the cylinders are for non-condensing compound. These engines, however, are built for condensing compound by simply changing the proportions of the cylinders as may be required for the steam pressure and power. The governor is positively driven. In this instance the distribution of power has been very well developed, and is really worth a visit

1898 Armature.



One-quarter Horse Power Motor, 1898 Pattern.



Interior View of One-quarter Horse Power Motor.
PARAGON MOTORS.

from anyone interested in the distribution of power over large works and areas.

The form of these engines is especially designed for direct-connected work, as the inside of the frame is entirely closed, preventing either oil or water from injuring the generator.

Paragon Motors.

The Paragon motor, which has lately become well known as a fan motor, is now being built in small sizes for general power distribution purposes. The sizes now in stock are one-twelfth, one-eighth, one-fourth, one-half and one horse power, and the motor is designed and made with all the care that is usually spent on large units. The general familiar features of the Paragon fan motor are embodied in these power motors, namely, iron-clad construction, enclosing everything but the pulley, with the circular field and toothed armature. The new motors are made with an iron base, with the edge turned up to form an oil pan, and are fitted with radial brushes, the pressure of which is adjusted by a screw and lock nut. Owing to the excellent magnetic circuit, low air-gap reluctance, etc., motors are of light weight and highly efficient for their size. The one-half horse power size, for example, weighs only 60 pounds. They are also made up as small-size motor-dynamos for the generation of alternating currents from direct currents, etc. This line of motors is handled by J. P. Williams, general agent, 39 Cortlandt street, New York.

Electric Railway Development at Home and Abroad.

English contractors (Dick, Kerr & Co. of London) have secured the order for the electrical equipment of the street railway systems of Madrid and Barcelona, Spain, but the sub-contract for the generators and full station equipment has been placed with the General Electric company of Schenectady. The Railway World of London states that 160 motor equipments will be required for these lines and that the full amount of the original contract is about $800,000. The following extract from a press dispatch from Schenectady, dated September 26th, is an interesting comment on the use of American electrical machinery:

"While Lord Kelvin was in the act of gratifying his intense curiosity about the General Electric works here, news came of the closing in New York of further contracts, employing English capital, for large electric railway systems in Dublin, Madrid and Barcelona. The amount involved is said to reach 2500,000. Lord Kelvin was asked his views on this matter. He said: 'I do not consider it out of the way or surprising that these orders should be placed here. England has not yet developed her electric railway work to as large extent as you have, and hence is buying, as she always does, in the best market to save money. She has the engineering and manufacturing talent, but lacks the opportunity. Here you have towns of 10,000 population springing up in a year, and they naturally want the latest and best, making a good demand which renders easy production on a large scale and also stimulates the older communities near them. We have no such developments in England, and the areas of our towns are smaller, so that the necessity of city transportation is not so keenly felt as with you.'"

The same state of affairs was recently considered by the Electrical Engineer of London, and the remarks of that journal are interesting as showing the British point of view: "We have been pleased to note that the English contracts for electric tramways are being placed more frequently with English contractors, and that in certain cases the English contractors have obtained important contracts abroad in the face of the direct opposition of agents from America. This state of affairs is gratifying to the profession, but the fact that the majority of the material used, even by English contractors, is obtained from America, is to be deprecated. The reason for this is to a certain extent to be found in the fact that the severe competition in America has reduced the prices; but, on the other hand, it is also the fact that in some departments the English manufacturers are not sufficiently prompt to take up the requirements of the new industry. We were informed, for instance, the other day by a large contracting firm that the steel poles for the construction of an important electric tramway they were equipping had been ordered from an English firm at prices which compared favorably with those of American goods. The order having been placed, considerable trouble arose from the delay in delivery, and the organization of the line was seriously impeded from this cause. Delays of this kind naturally tend to keep the trade out of the country. Another point we have noticed recently, when inspecting new traction plant, is that the American engine builders have paid particular attention to the design of their engines for traction work, whereas the tendency of the English manufacturers is to supply an engine which has been found suitable for electric lighting purposes. It by no means follows that this engine will be suitable for traction work, because the rapid way in which the load varies and the short duration of the periods of extremely heavy loads strain both the engine and its governing arrangements most severely. If our manufacturers will keep themselves to the fore in matters of detail of this kind, we see no reason why the present procedure of ordering goods from abroad should continue. The boom in electric traction which is now commencing will then benefit the English profession and enable the manufacturers to hold their own in colonial tramway equipment. Not only in English-speaking countries, but on the Continent electric tramway schemes are being decided upon every day, more particularly, perhaps, in the mountainous regions and other places where there is a plentiful supply of water."

In Australia the American cars are very favorably received, to judge from the following note in Transport: "The railway commissioners of New South Wales are experimenting on the Sydney tram lines with an open car of American make and design. The new car is the theme of local admiration and of eulogistic notices in the press. The old car, which is its companion on the road, is practically deserted. Everybody, in fact, rushes to this elegant and attractive vehicle, which not long ago was publicly tried for the first time. It is said that as a summer car it would be difficult to surpass it. It is perfectly open from end to end, the sun, wind or rain being excluded by cleverly designed blinds, which can be lowered or raised at will, and which, being on the automatic principle, stop just exactly in the position wished. The seats are reversible, being made of light wood, beautifully polished. It runs particularly smoothly, and has accommodation for 40 passengers, with a small cab at either end for the man controlling it. This, of course, is when the car is driven by electricity. The real name is 'The Brill Car,' being manufactured by the firm of that name in Philadelphia. The truck on which it runs is called the 'Peckham' truck. The car being about half the weight of those at present in use, will effect a large saving in haulage."

CORRESPONDENCE.

New York Notes.

New York, September 28.—One of the witnesses of last week before the Supreme Court Rapid Transit Commission of Inquiry was O. T. Crosby, the well-known electric railroad expert. Mr. Crosby gave much testimony regarding the average of grades, rates of speed and as to the power necessary to bring a train traveling at 48 miles an hour to a stop in 22 seconds. Speaking in a general sense, Mr. Crosby expressed the opinion that it would be cheaper to operate the proposed underground road by electricity than by steam power. The years of delay in this matter of providing rapid transit for New York is a source of mortification to the citizens of this city. The Scientific American says that it is doubtful if the gentlemen who compose the Supreme Court Commission have ever carried a more serious responsibility than that just now incurred in deciding the fate of the plans for rapid transit which were prepared by the New York Rapid Transit Commission. "It is to be hoped," adds this journal, "that a decision will be rendered at the earliest possible date, for the reason that the consolidation of the present several municipalities which will constitute Greater New York will take place on the first day of January, 1898, and if the immediate construction of the proposed lines is to take place, the contracts must be let before that date. With the close of the year the present governing bodies of the city will cease to exist, and before any progress could be made with rapid transit it would be necessary to form a new commission and begin over again the tedious preliminary work. Should the judgment of the commission be unfavorable or should it be rendered too late for the commencement of construction, the city will find itself exactly where it started many years ago, and all the time, trouble and expense to which it has been put will have gone for nothing." In conclusion the Scientific American cites the work on the Boston subway—which was not projected until some years after the Rapid Transit Commission of New York had commenced its labors—and notes with shame that "even at this late hour the consummation of a similar work in the metropolis is in danger of indefinite postponement."

The troubles of the Metropolitan Street Railway company continue. John F. White has written to the mayor to say that the company is, without authority, converting its cable road in Columbus avenue, between Fifty-ninth and Sixty-fifth streets, into a line which shall be operated either by cable or a conduit trolley system. This charge is said to be true by officers of the Department of Public Works, who state that the company has no permit to tear up Columbus avenue. In Broome street, too, the company seems to have evinced a disposition to grab more than it is entitled to. On Saturday Justice Lawrence, in the Supreme Court, granted an injunction restraining the Metropolitan Street Railway company from tearing up Broome street for the purpose of laying an electric conduit. August Eickhoff, an owner of abutting property, who obtained the injunction, says that when the company some time ago obtained permission to change its motive power on the Fourth avenue branch the permit gave the company authority to change the single track operated in Broome street. The company, however, Eickhoff declares, seized the opportunity to lay an extra track without authority. M. S.

Northwestern Notations.

Minneapolis, September 28.—A company with Matthew Edwards at the head has been formed at Lancaster, Wis., and applied for a franchise for electric lighting.

The Electrical Installation company of Chicago has filed a claim for a lien on the plant of the Citizens' Traction company at Oshkosh, Wis., for work done on that line for the Winnebago Construction company.

Supplementary proceedings have been begun against the Duluth street railway at Duluth, Minn., to collect a judgment of $5,663.

The Chatfield, Minn., electric light plant will be ready for operation about October 1st.

Work is being pushed on the Montana Power company's electrical plant near Butte, Mont. The company will secure power from the Big Hole River, and it is expected to have electricity from the plant by March 1, 1898. The capacity will be 4,000 horse power to start with.

A mass meeting of the property owners was held in Sioux City, Ia., to protest against the extension of the franchises of the various traction companies there. The Sioux City Traction company wants its franchise extended to 1983.

Grand Forks, B. C., will put in an electric light system.

The Benton Power and Traction company has been incorporated to put in a water power at Sauk Rapids, Minn., and generate electricity for street railway, electric lighting, and manufacturing purposes.

Henry E. Combacker and others of Osceola, Wis., have applied for a franchise for electric lighting.

It is reported that an English syndicate has an option on the Jay Cooke water power near Duluth, Minn., and proposes to develop the water power and transmit electrical power to Duluth and Superior.

There is a scheme on foot to build an electric railway line from Charles City, Ia., to Hampton, Ia.

W. M. Hewitt of Stillwater, Minn., is preparing to take hold of the proposed Oshkosh, Berlin and Omro, Wis., electric line, provided certain matters relative to franchises are adjusted satisfactorily.

It is proposed to triple the number of electric street lights in St. Paul, adding 240 arc lights in the business part of town.

The proposed arc light system at Kaukauna, Wis., calls for 40 arc lights of 1,200 candle power each.

The Mankato Gas and Electric Light company of Mankato, Minn., has contracted with the city to furnish electric street lighting for five years. The council has dictated lower prices for electricity to consumers.

The electric fire-alarm system of St. Paul will probably be modernized at a cost of $7,000.

The St. Paul council has passed the ordinance requiring the street railway company to put in a loop to the Union Depot. It is understood, however, that the street railway company will refuse to comply with the ordinance. The ordinance requiring the Selby avenue cable to be supplanted by electric power has also passed the council and has gone to the mayor for approval.

Geo. W. Hayford, secretary and treasurer of the Electrical Engineering company, reports that business is at least 20 per cent. better than at this time last year.

Electric light plants are being constructed at Graceville and Argyle, Minn., and at Valley City and Madison, S. D.

The Minneapolis General Electric company is laying an underground cable for a three-phase power transmission to operate rotary transformers, and from these transformers will feed directly into the Edison three-wire system in the Edison building from the East Side water power station. The present steam-driven Edison station will be abandoned entirely.

The work of repairing the St. Anthony Falls Water Power company's new dam, which was injured by the high water last spring, has been commenced. C.

PERSONAL.

Gerald W. Hart, the president of the Hart & Hegeman Manufacturing company of Hartford, Conn., was a recent Chicago visitor. Mr. Hart has a long list of friends in the West, where he is well known and well liked, and in company with Geo. S. Searing, the popular Chicago representative of the company, he called on many of them last week.

Friends of Edward L. Draffen will be interested to note that he has joined the ranks of the Fort Wayne Electric corporation. Mr. Draffen was for many years with the New York office of the General Electric company under District Manager Charles D. Shain. Before his connection with the General Electric company he was identified with the Westinghouse interests.

ELECTRIC LIGHTING.

An electric light plant is proposed in Cumberland, Md., and it is said that Frank Rae of Chicago is preparing the plans.

The electric light plant of Fernandina, Fla., is to be removed to a new brick power house and enlarged by the addition of new engines, boilers and dynamos.

Keosauqua, Iowa, proposes to have electric lights—about 10 arcs and 400 incandescent lamps. It is proposed to use the waterworks engine to drive the dynamo.

The Borough of Manhattan Electric company, to furnish electricity for lighting, heating, and power purposes in New York city, was incorporated September 22d with a capital of $100,000. The directors are Charles A. Lieb, Hugh H. Harrison, Joseph F. Darling, Albert S. Williams, Charles P. Blaney, Robertson Honey and Edward Schmidt of New York.

ELECTRIC RAILWAYS.

The railroad commissioners of the state of New York have received an application for a certificate authorizing the construction of 60 miles of cable road from Coxsackie to Middleburg. Four companies were named in the application as being interested in the proposed road. They are the Middleburg and Oak Hill Traction company, the Coxsackie and Greenville Traction company, the Windham Traction company and the Oak Hill Traction company. The companies are capitalized at $1,000,000. The promoter of the system is W. J. Raines,

a brother of State Senator John Raines, author of the now famous Raines law.

On the night of Wednesday last the large power house of the Capital Traction company of Washington, D. C., was totally destroyed by fire. The building occupied nearly the entire square between Pennsylvania avenue and D street, and from Fourteenth to Thirteenth and One-half streets. It was at one time feared that some of the government buildings would be damaged, but the fire was confined to the immediate locality of the power house by the work of the firemen. The plant had a capacity of 1,600 horse power, and the loss on building and machinery is several hundred thousand dollars. All of the cable lines of the city will be incapacitated for some time, and some of the electric roads will be crippled.

President Russell B. Harrison of the street railway company of Terre Haute, Ind., has formally announced to the public that there will be a week of slow transit for the purpose of showing the quality of service that would result should an ordinance ending in the council be passed. Mr. Harrison has some bitter opponents, and they have prepared an ordinance which provides for several changes in the methods of operating the trolley system. Recently there were two distressing accidents and they form the basis for the proposed ordinance. Under the new schedule the cars will be run at about one-third speed, stop at near crossings, and come nearly to a standstill at every intersecting street, regardless of the fact as to there being passengers to get off or on. All cars have to run to a central point in Main street, but to lessen the danger in that street transfers will be given from cars on other lines where they intersect Main street.

Considerable interest is being manifested in the completion of the Ballston terminal railroad, at Ballston Spa, N. Y. This road has been contemplated for some time, and now, under the energetic management of J. C. Stanton, gives evidence of early completion. The power house, which is a commodious and substantial structure, of modern ideas, is now completed. The plant includes Babcock & Wilcox boilers, Hamilton-Corliss engines. Westinghouse electrical apparatus, Brill cars and Mayer & Englund overhead material. The road bids fair to be completed before the close of next month. The road is largely a freight road, and the company will handle the freight by electrical locomotives designed especially for its use. These locomotives are now being erected at the car works of the J. G. Brill company in Philadelphia. The passenger service will be taken care of by the ordinary passenger cars.

TELEPHONE.

The Southern Bell Telephone company has purchased a building in Birmingham, Ala., for $14,000, which it will improve and enlarge for the use of its works.

Wm. R. Eareckson and Arthur Williams have petitioned the county commisssioners for authority to construct a telephone line from Halethorpe to Elk Ridge, Md.

W. H. Preece tells a story about the early days of the telephone: In order that the queen might test the new invention he put Osborne, Portsmouth and London in communication, and arranged that a band should play while her majesty was at the other end of the instrument, but the queen was detained, and before she arrived the band had been sent away. It occurred to Mr. Preece to act as the band himself, so he stepped to the instrument and hummed into it "God Save the Queen," and asked if her majesty recognized the tune? "Yes," she said, "it was the national anthem—but very badly played."

E. B. Overshiner of the Logansport (Ind.) Mutual Telephone company has just finished a telephone plant in the city of Winamac, Ind., for 70 subscribers. He has built a toll-line connecting the new plant with the Logansport exchange, which gives it outside connections with 200 miles of toll-lines and 80 towns and cities in Indiana and Illinois. He will shortly build a metallic circuit to Monticello, Ind., giving his company a metallic circuit as far west as Kankakee, Ill., Lafayette, Ind., and all the principal towns in western Indiana and eastern Illinois. The Logansport exchange now numbers 400 subscribers and is still growing.

Writing from Stockholm, a recent correspondent says: "There are some things they do much better over here than we do in America, and the telephone is one of them. I venture to say there are more telephones in Stockholm than in any other city of the world in proportion to population. Nineteen thousand is the number of subscribers in this city of a quarter of a million souls. Nor is it surprising that the number is so great, as one may have a telephone in his house at a cost of $10 a year, and in his office or shop for $16 a year. In addition to the 19,000 telephones in the city system, there are 2,500 instruments in the suburban towns, many of them 40 or 50 miles distant, which city subscribers may call up without extra charge. To one who is assessed $110 a year for a telephone in Washington, and is besides compelled to pay 10 cents every time he wishes to call up his own office from another 'phone, there appears a striking contrast between the telephone charges of the American and the Swedish capitals."

ELECTRICAL SECURITIES.

The Edison Electric Illuminating company of Brooklyn reports gross earnings for the eight months ended August 31st of $561,721, an increase of $38,638 as compared with the corresponding period of last year, and net $252,719, an increase of $24,388.

The Cambridge (Mass.) Electric Light company has petitioned for approval of an issue of new capital stock at par value of $100,000 for the purpose of paying its floating debt and enlarging its plant. The petition has been granted by the Board of Gas and Electric Light Commissioners.

The North Shore Traction company of Boston reports gross earnings for August of $177,394, an increase of $1,831 as compared with the same month of last year, and net $100,800, an increase of $3,763. For the seven months ended August 31st the gross earnings were $336,259, a decrease of $13,044 as compared with the corresponding period of last year and net $188,576, a decrease of $7,802.

The Columbus (Ohio) Street Railway company reports gross earnings for August of $52,365, a decrease of $1,156 as compared with the same month of last year and net $26,007, a decrease of $775. For the seven months ended August 31st the gross earnings were $440,102, a decrease of $38,095 as compared with the corresponding period of last year, and net $226,586, a decrease of $15,429.

At the second annual meeting of the stockholders of the Union Traction company of Philadelphia last week, John B. Parsons, vice-president and general manager, was elected a member of the board of directors, and A. J. Cassatt, who was elected to fill the vacancy of C. F. Fox, resigned his place on the board of directors. The report of nine months' operation shows a deficit of $851,934, which is a decrease of about $350,000 from the deficit of the corresponding nine months of the previous year.

"Matthew Marshall," the noted financial authority of the New York Sun, utters a note of warning against the prevailing rage for speculation in stocks. He calls attention to the fact that the conditions of to-day are somewhat similar to those that prevailed in 1893. "People bought stocks then as eagerly and at as inflated prices as they are buying them now," he says. General Electric is mentioned as an example. That stock sold four years ago as high as 114, upon the report that its earnings were "far beyond the amount needed to pay eight per cent. on its stock," but "General Electric has paid no dividends at all since 1893," he adds.

Talk of a consolidation of all the surface roads of Chicago under the Yerkes-Elkins-Widener control has been revived, and from Philadelphia comes a statement of the proposition which the Yerkes interests made to the stockholders of the Chicago City Railway company, who are the chief objectors to the scheme. It includes a guaranty of the $4,619,500 4½ per cent. bonds of the South Side company and the payment of 12 per cent. per annum on the capital stock of $12,000,000. The West Chicago stockholders are offered six per cent. on $13,189,000 of stock and a guaranty of all fixed obligations, and those in the North Chicago road 12 per cent. on the $6,600,000 of stock. The Metropolitan Traction company, in the event of consolidation, it is claimed, would be the central company, and its capital stock would be increased to $50,000,000. A director of the Chicago City Railway company is authority for the statement that no proposition from the Yerkes interests has met with favor. As the City railway has been paying 12 per cent. the offer has no inducements.

A financial paper of recent issue states that a foreclosure case which involves about $600,000 is being heard in the Wayne Circuit Court of Detroit. The old Brush Electric Light company sold that amount of bonds to the Peninsular Electric Light company in 1893. The latter company was formerly known as the Fort Wayne Electric Light company. Clarence A. Black, who was then traveling in Japan, was made trustee of the bonds, and E. W. Pendleton, Richard Fyfe and W. C. Colburn were made a committee to look after the running of the plant. It was the intention to make this trust permanent by securing the consent of the bondholders, but when Mr. Black returned to Detroit, R. W. McDonald, owner of $50,000 of stock, had transferred his interest to the American Trust and Loan company, which concern refused to consent to the plan. Trustee Black was then requested by the holders of $100,000 worth of the stock to begin foreclosure proceedings, the Peninsular Electric Light company having defaulted by the non-payment of six months' interest.

MISCELLANEOUS.

A playful French contemporary, L'Electricien, gravely cites an instance of great presence of mind on the part of a Frenchman traveling in a New York electric cab. The cab suddenly stopped, and one of the occupants—a cool-headed engineer—investigated the cause and found that the fuse had blown. It was the work of an instant to take a tablet of chocolate out of his pocket, remove the tinfoil in which it was wrapped and connect it in place of the fuse, so as to allow the cab to proceed gaily on its way again.

TRADE NEWS.

Owing to a large increase in the business of the American Rheostat company of Milwaukee, the capital stock has been increased to $25,000.

The Zimmerman Cycle company of 19 York street, West, Savannah, Ga., intends to put in a complete line of electrical goods in connection with its present business. It requests catalogues of electrical machinery, material and supplies.

Charles M. Proctor, president of the Proctor-Raymond Manufacturing company of Buffalo, N. Y., was in Chicago last week. Mr. Proctor is making a trip in the interest of his company and is presenting to the various supply houses an extremely attractive line of new specialties.

"We manufacture a strictly high-grade lamp only," and "by purchasing from us you save the dealer's profit," are the claims for business urged by the United Electric Improvement company, Nineteenth street and Allegheny avenue, Philadelphia, manufacturer of incandescent lamps. Sample orders of lamps may be returned "if they are not equal to the best."

George W. Conover, with office in the Monadnock block, Chicago, has been appointed western agent for the Puritan Electric company. He will handle in the vicinity of Chicago the Puritan alternating arc lamp, which has been on the market for the past year. Mr. Conover is particularly adapted for this position, as his experience in selling arc lamps has covered a long period.

In addition to his engineering business Forée Bain of Chicago is now engaged in soliciting patents in the United States and foreign countries. Mr. Bain has had a practical experience of 20 years in designing, manufacturing and installing apparatus for telegraphy, telephony, electric lighting and power. He is also familiar with gas engines, steam engines and other branches of applied electricity and mechanics.

One of the busiest belting firms in the country is the Shultz Belting company, St. Louis, whose reputation as a manufacturer of rawhide belting is known far and wide. The Shultz company's product is extensively used, not only in the United States, but all over the civilized world. At the present time the company has all it can possibly do to fill its orders and its capacity is taxed to the utmost. The Shultz company is one of the oldest firms in the business and its standing, especially in the electrical trade, which has used Shultz belting extensively, could not be better.

"Wire in Electrical Construction" is the title of a useful little book issued by the John A. Roebling's Sons company of Trenton, N. J. The work is gotten up in engineers' pocketbook style, and it seems to be accurate and reliable, so far as it goes. The object is "to give in a convenient form the properties and dimensions of bare and insulated wires and cables used in electrical construction." This is done in the form of tables, and the belief is stated in the preface that some of the matter is new. The book is well printed and contains very little advertising matter. It is a dignified trade publication of the best class and should be of considerable assistance to the users of electrical wires.

The Western Electrician has received the 1897 catalogue of P. & M. Herre, Berlin, Germany, manufacturers of incandescent lamps. The pamphlet is illustrated and the text is printed in German, French and English, the prices of the articles listed being given. The English is faulty, but the sense can usually be made out. Beside a full line of incandescent lamps and parts thereof, there are also shown electric contact thermometers, Geissler tubes, Crookes tubes and other electric specialties, which the firm manufactures. Those interested in these goods may examine the contents of the catalogue at the offices of the Imperial German consulate in Chicago (room 826 Schiller building), where free copies may be had.

Edward Wertheim, 55 South Canal street, Chicago, recently incorporated under the laws of Illinois his prosperous business under the new name of the Advance Packing and Supply company. Mr. Wertheim, as is pretty generally known, was the sole owner of this business, and he becomes the president of the new organization. As Mr. Wertheim is familiar to the electrical trade through his large sales of high-grade carbons, it is a matter of interest to note that the new company is still pushing an imported carbon manufactured by the Union Carbon company of Kronach, Germany. This agency has been in the hands of Mr. Wertheim for a long time and will receive an additional impetus in the new company. Besides its regular brand of carbons for open arcs, the Advance Packing and Supply company is introducing a special high-grade

carbon under the name of Germania, suitable for inclosed arc lamps, the main features of which are long life and minimum deposit during combustion.

Mr. Isaacs of K. McLennan & Co. states that while no doubt the conditions in the business world have materially improved while the sales of Gale's commutator compound have increased, he does not believe that such increase in the sales of their compound could fairly be attributed to the times. Gale's commutator compound has become a staple article, he says, adopted and in regular use by nearly every power plant and central station in the United States and Canada and a large number of isolated plants. "Doubtless," continued Mr. Isaacs, "the reduction in price has worked some increase, as some of the smaller plants may have felt that the former price was too high." The office of K. McLennan & Co. is at 1128 Marquette building, Chicago.

BUSINESS.

Everyone desires to keep informed on Yukon, the Klondyke and Alaskan gold fields. Send 10 cents for large compendium of vast information and big color map to Hamilton Publishing company, Indianapolis, Ind.

"Coal Handling for Steam Generation" is the title of a valuable pamphlet issued by the C. W. Hunt company of New York and devoted to the explanation of the numerous features of the Hunt noiseless conveyor. Many plants using this apparatus are cited to show the high opinion entertained by engineers. Electric lighting and street railway plants form a considerable part of the installations described.

The Garvin Machine company, Spring and Varick streets, New York, has just issued List No. 20 of new and second-hand machinery in stock for immediate delivery. The list of new machinery comprises, besides the company's own manufacture, many of the well-known makes of lathes, planers, shapers, drill-presses, presses and shears, grinding machines, miscellaneous machine tools and special bicycle machines. The second-hand list is nearly as complete, and has also a number of the Garvin company's well-known milling and screw machines listed, which are in as good condition as when new. The list will be sent to anyone desiring it.

The Burnley Battery and Manufacturing company of Painesville, O., is placing upon the market a new type of primary battery which is a radical departure from existing methods of construction. It consists of a glass jar and a cylinder of thick zinc, in which is placed the negative electrode and suitable depolarizing matter, so that the zinc cylinder, depolarizing agent and carbon electrode form a compact body. At the bottom of this body is a porous septum for the admission of the necessary moisture. This battery starts to work with a full force the instant it is set up, giving 1.5 volts and from eight to 10 amperes. The Burnley dry battery is well known, and scores of commendatory letters testify to its efficiency.

The demand for knife switches for motor wiring and general electric light work has increased very much of late, and knife switches are sold in large quantities. The F. & L. motor knife switch, handled by the Electric Appliance company, is one of the most desirable switches on the market in this line, being a good article at a low price. The Electric Appliance company carries a large and complete stock of these goods, and is prepared to make prices that will get the business.

Among the many western concerns that have felt the wave of prosperity is the Farr Telephone and Construction Supply company, 342 Dearborn street, Chicago, which has received more than its share of telephone orders and supplies, particularly within the last two months. While this is due to a large extent to the company's energetic management, the excellent reputation its goods have earned is no doubt responsible in a large measure for the largely increased business. The company has received orders from all parts of the United States and, in addition, from many foreign countries. The catalogue and handbook of information which the Farr company is willing to send to anyone on request has met with great favor among telephone users, as it contains much useful information for those desiring to put up telephones.

ILLUSTRATED ELECTRICAL PATENT RECORD.

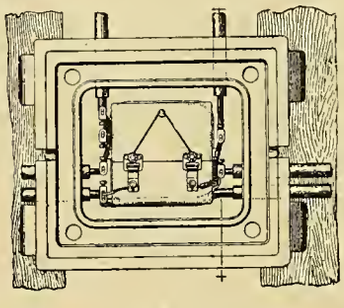
Issued September 21, 1897.

590,238. Electric Arc Lamp. William R. Ridings, George F. Bull and Llewellyn B. Codd, Birmingham, England. Application filed May 28, 1896.

A brake mechanism for an electric arc lamp comprises a friction wheel, a set of toggle levers, a pad carried at the joint of the toggle levers, electro-magnetic devices for operating the levers to cause the pad to clutch or engage with and leave the wheel, and connections between the wheel and the carbons.

590,263. Electric Measuring Apparatus. John C. Henry, Denver, Colo. Application filed July 3, 1897.

The magnet is placed in a shunt around the field magnet of the motor, and alarm devices are operated by the magnet.



NO. 590,420.

590,267. Electric Alarm. John C. Kenmouth, Spearfish, S. D. Application filed January 20, 1896. Renewed June 14, 1897.

The combination with an electric circuit, a battery, an electric bell and box inclosing the same, a strong flat spring having one end secured to a plate and electrically connected to one of the posts, a contact point electrically connected to the other post, and against which the spring normally bears, a trigger having one end suitably secured to the plate, and having a notch therein into which the end of the spring catches when it is moved, and of engagement with the contact point, and a snare-wire connected to the outer end of the trigger.

590,299. Signal Mechanism. John P. Coleman, Swissvale, Pa. Application filed March 27, 1897.

An electric motor, an electrically controlled connection between the motor and signal, and a motor-brake mechanically released by the signal, are important features.

590,300. Signaling Apparatus. John P. Coleman, Swissvale, Pa. Application filed April 24, 1897.

An electric motor is separably connected to an appliance for controlling a moving train, a magnet having high and low resistance coils for controlling such connection, and a generator common to the magnet and motor, the high-resistance coil being in a shunt around the motor.

590,301. Signaling Apparatus. John P. Coleman, Swissvale, Pa. Application filed May 3, 1897.

Catches are used for locking the signal rod and the holding rod to the frame, and electrically controlled dogs for shifting the catches.

590,303. Signaling Apparatus. John P. Coleman, Swissvale, Pa. Application filed May 29, 1897.

There is the combination of a crank connected to a signal, a weight for rotating the crank, mechanism for controlling the rotation of the crank, an electro-magnet controlling such mechanism, and a motor operative regardless of the position or movement of the signal for raising the weight.

590,304. Common Battery Multiple Switchboard. Henry M. Crane, Boston, Mass. Application filed August 9, 1897.

Provision is made for a main or sub-station circuit having plug-socket switchboard connections at a central station, and plug and switch-cord complementary connectors, each plug and cord having two main circuit conductors looped through a current generator, with a third conductor for the plug and cord forming a part of a local signal and test circuit also containing a source of current and divided into two parallel branches, a relay in one of the main conductors controlling the continuity of one of the branches, and adapted when excited to close the same, a signal switching relay in the branch controlling the continuity of the other branch, and adapted when excited to open it, and a supervisory signal in the other branch, whereby the signal branch is maintained open and the signal undisplayed during a conversation, but is closed and the signal displayed on the close of such conversation.

590,310. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa. Original Application filed October 27, 1886. Divided and this application filed September 12, 1887.

An electrically propelled vehicle has a frame supported upon the axles or axle-boxes independently of the springs supporting the car-body, in combination with a horizontally movable collector arm hinged thereto, a collector wheel journaled upon the free end of the arm, and a working conductor upon which the collector wheel runs.

590,373. Interior Conduit for Buildings. Harry G. Osburn, Chicago, Ill. Application filed November 1, 1895.

A metallic casing or tube having an oval or elliptical cross-section contains insulating tubes disposed within the casing for conducting wires.

590,374. Interior Conduit for Electrical Conductors. Harry G. Osburn, Chicago, Ill. Application filed March 23, 1896.

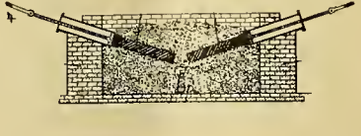
An outer casing or sheath incloses the insulating tubes, the walls of the casing being formed to give them a spring-like action, whereby the casing adapts itself to tubes slightly irregular in form or size.

590,386. Electric Trip-knife Switch. Augustus C. Carey, Lake Pleasant, Mass. Application filed May 24, 1895. Renewed June 29, 1897.

Contact posts and a tilting knife carrier are combined with a tilting device comprising a lever having a spring connection with the knife carrier and provided with projecting fingers, and spring-stops provided with stop-lugs which engage angles on the knife carrier positively to support the knife carrier in either of its tilted positions.

590,398. Electric Signaling. Simon de Jager, Paterson, N. J. Application filed January 23, 1897.

A system of transmitting electrical signals comprises a source of electricity, a main circuit, a transmitting device with means for sending a predetermined number of impulses of one polarity, followed by an impulse of the opposite polarity, a selecting device comprising two or more groups of magnets, contacts in the main circuit controlled thereby, a separate circuit in the selecting device and contacts therein also controlled by the magnets, the magnets responding to the main or the separate circuit upon the automatical closing of the corresponding contacts, and a receiving device also controlled by the contacts.



NO. 590,514.

590,420. Electric Railway. Robert Lundell, Brooklyn, N. Y. Application filed July 18, 1896.

A switch-box is provided with a mud-groove near its top, in combination with a cover provided with two downwardly extending flanges, one of which is adapted to rest in the mud-groove and the other to surround the switching mechanism when the cover is located in position.

590,427. Coin-operated Electrical Apparatus. Webb B. Wheeler, Lincoln, Neb. Application filed March 16, 1897.

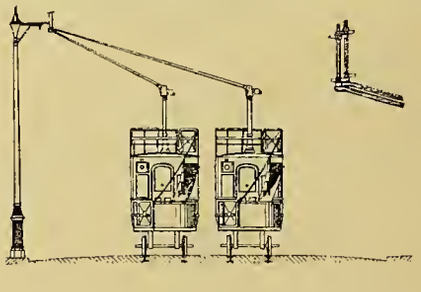
An electro-magnet is mounted adjacent to the clockwork mechanism; an armature lever is pivotally supported above the clockwork mechanism and adapted to operate to stop the balance-wheel; a coin-chute is mounted on the base-plate adjacent to the clockwork mechanism; a pin wheel is connected with the clockwork mechanism and is provided with pins which project in the direction of the coin-chute, a lever is pivotally connected with the side of the coin-chute and is adapted to swing in the direction of the wheel, the clockwork mechanism, the magnet and lever being in an open electric circuit which is adapted to be closed by a coin dropped into the coin-chute, and by which the armature lever is operated.

590,466. Commutator and Means for Assembling Same. Sidney H. Short, Cleveland, Ohio. Application filed July 12, 1897.

A commutator cylinder is mounted on the hub, and an expansible ring interposed between the commutator cylinder and the hub.

590,497. Electrical Igniting Device for Lamps. Svend M. Meyer, Brooklyn, N. Y. Application filed April 27, 1895.

A central draft oil lamp is provided with a high resistance electrical conductor located adjacent to the upper end of the wick tube and attached to and supported by the air distributor.



NO. 590,527.

590,514. Process of Producing Metallic Carbides. Alfred H. Cowles, Cleveland, Ohio. Application filed August 19, 1895.

The process described of making calcium carbide consists in causing a current to pass between electrodes laterally projecting into a mass of intimately commingled calcium oxide and carbon of such extent that a material proportion thereof will remain undecomposed by the passage of the current, and in gradually separating the electrodes as the material between them is reduced, so as to produce between the electrodes a body of the carbide surrounded by an undecomposed mass of the mixture.

590,527. Trolley for Electric Railways. William E. Kenway, Birmingham, England. Application filed May 4, 1897.

The "invention" provides for a double-track electric railway and a single overhead electric conducting wire, of an inclined arm adjustably supported on each car and carrying at its outer end a vertical rod or contact-maker provided with rotatable disks or buttons at top and bottom, the contact-maker on the arm of the car most distant from the overhead wire being adapted to pass with a sliding or rolling motion over the contact-maker on the arm of the other car when two cars are passing, and pressure mechanism for preserving substantially continuous contact of the contact-maker with the side of the overhead wire.

590,548. Process of Producing Hydrates or Other Salts of Alkaline Metals. Charles Kellner, Hallein, Austria-Hungary. Original application filed November 12, 1892. Divided and this application filed July 7, 1896. Patented in Germany August 17, 1892; in France September 26, 1892; in Belgium September 26, 1892; in England September 26, 1892; in Sweden September 26, 1892; in Norway September 26, 1892; in Italy September 30, 1892; in Austria-Hungary December 28, 1892; in Russia May 28, 1894, and in Switzerland July 14, 1895.

This method of producing hydrates or other salts of the alkaline metals consists in forming at one point a given quantity of amalgam by electrolysis of a solution of a suitable salt in presence of a mercury cathode, and simultaneously oxidizing a substantially equivalent quantity of the alkaline metal contained in the amalgam at another point by constituting the latter the anode (zinc pole) of a galvanic cell containing a liquid reagent and a cathode electro-negative to the amalgam and short-circuited therewith.

Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, OCTOBER 9, 1897. No. 15

Elevated Railway Progress in Chicago.

Since Sunday, October 3d, the Union elevated railway loop in the down-town business district of Chicago has been in regular use for the trains of the Lake Street Elevated Railroad company. Within a very few days the trains of the Metropolitan West Side Elevated Railroad company will also be using the new structure, and probably within a month the South Side service will be added. Work on the Northwestern road on the North Side has been suspended for the present, and the date of the completion of that road, and its consequent connection with the loop, is uncertain. But the West and South Side elevated railroad companies are using, or are about to use, the loop, and therefore a great improvement in Chicago's rapid-transit facilities has been secured, although at the cost of some disfigurement and darkening of a few down-town streets.

As all readers of the Western Electrician are aware, the Union Loop is an electric railroad. It is owned and operated by a distinct corporation—the Union Elevated Railroad company, incorporated nearly three years ago, with a capital stock of $5,000,000—which is installing its own power plant at Market and Congress streets, with a capacity of 6,500 horse power. The work on the power house has been delayed by workmen's strikes and other causes, and the machinery will not be ready for operation until about December 1st. It is interesting to note that the plant will be connected with the structure by 11 lead-covered positive cables of 1,500,000 circular mils area each and by an equal number of bare copper cables of 1,000,000 circular mils each. These connections are now being made, and temporarily the loop is supplied with current from the Hawthorne avenue station of the North Chicago Street Railroad company through a special switchboard in the interlocking tower at Lake street and Fifth avenue.

The loop consists of two tracks, and each track is separately wired and entirely distinct from the other. Thus there are two track loops on one elevated structure. Each track is divided into two feeder sections, and as there is a carefully planned system of switches and cross-overs, by which, if necessary, trains can be transferred from one track to the other, and as several sources of current will be available when the loop is in full operation, it will be a very serious emergency which will stall the whole system. Of course there is a peculiar necessity for providing a very large factor of safety in the operation of the loop, for if it should become disabled the whole elevated railroad service of the city would be crippled. Normally, two companies will use each track, the Lake Street and Northwestern trains on the outside track and the South Side and Metropolitan trains on the inside. Thus in Fig. 1 the Lake Street train is shown on the outside track, although it is proceeding in a direction contrary to the usual rule of the road in American railroad operation. The two sets of trains will proceed in opposite directions around the loop, so that passengers going from one loop station to another can get a train in either direction. The photograph reproduced in Fig. 1 was taken from an upper floor in the Old Colony building at Dearborn and Van Buren streets, and it shows a portion of the Van Buren street leg of the loop, looking east, and the turn into Wabash avenue in the distance. A three-car Lake Street train, westbound, is just pulling out of the station at State and Van Buren streets.

FIG. 1. ELEVATED RAILWAY PROGRESS IN CHICAGO.—A VIEW ON THE UNION LOOP.

A glance at the map on the next page, which is a reproduction of a drawing made for the Economist (Fig. 2), shows the importance of the Union Loop to the elevated roads of Chicago. By its use passengers will be enabled to go by these lines from one division of Chicago to either of the others without descending to the ground. Indeed, in the case of a transfer between the South Side and Metropolitan trains, or between the Lake Street and Northwestern, the passenger will simply go from one end of the platform to the other, passing through the ticket office to pay his fare. In connecting between trains on different tracks the traveler will go down a few steps, through a passageway under the tracks and up on the other side.

The loop is about two miles long and is leased, with power, to the four companies operating long lines. The Union Elevated Railroad company has no cars of its own, but supplies current through contact rails to the motors of the tenant companies. It has agreed to pay to the city from its receipts, after deducting $250,000 per year for interest on its bonds, during the five-year period from January 1, 1897, to December 31, 1901, both inclusive, five per cent. per annum; during the five-year period from January 1, 1902, to December 31, 1906, 10 per cent. per annum; during the 10 year period from January 1, 1907, to December 31, 1916, 15 per cent. per annum; during the 15 year period from January 1, 1917, to December 31, 1933, 20 per cent. per annum; for the remaining term, approximately 15 years, 25 per cent. per annum. The lease in each case provides that rental dues shall begin to accrue 10 days after it is executed. Each contributing company shall pay to the loop company one-half cent per passenger on its whole paid traffic. Also each road shall bear such proportion of the total cost of operating and maintaining the loop power house, including ground rental, as the total number of car-miles which it runs over the loop bears to the total number of car-miles run over the loop by all the roads; also, such proportion of the total cost of operating and maintaining the loop itself as the total number of passengers it carries bears to the total number of paying passengers carried by all the roads using the loop. If the total rental, as thus computed, paid by all the roads does not equal a minimum rental of $250,000 (the interest on the authorized bond issue), then whatever deficit there is will be paid by each of the roads in the ratio which the total number of paying passengers it carries bears to the total number of paying passengers carried by all the tenant roads. The case of the Northwestern "L" is met by a provision that if any road is not ready to use the loop when the latter is ready for use, then that road's rental is to consist of a payment of $62,500 a year, to be paid in monthly installments. The rentals from all the roads are to be paid monthly, on the 15th. The management of the loop will rest with a board of managers composed of the presidents or receivers of the roads patronizing it. This board has appointed S. S. Neff as superintendent of the loop. The loop company is controlled and largely owned by C. T. Yerkes.

The full operation of the loop will make necessary several changes by the contributing companies. For one thing, the present terminus of the

Metropolitan road on Franklin street will be abandoned. The Metropolitan owns the five-story building at that point, which will be remodeled for business purposes. The South Side Elevated Railroad company is building the connecting spur in Harrison street from its present line to the loop's extension in Wabash avenue. The company has purchased 50 feet of ground in Harrison street, south side, just east of the alley. The buildings on this property are now being torn down to make room for the curve.

At first the South Side trains will be pulled around the loop by the present steam locomotives. This will afford a fine opportunity to contrast steam and electric traction on the same railroad. But within a few months the Fortieth street power house of the South Side company will be ready to provide the current for the electrical operation of the road, and then there will be no more steam locomotives on the elevated railroads of Chicago. A large number of men are engaged on the transformation of this road. The third rail and bonding has been completed from the Stony Island avenue terminus as far north as Thirty-second street. The machinery foundations at the power house are being put in as rapidly as possible and the cars are being equipped at the Wells & French works. The work of elevating the structure 11½ feet at the railroad crossing at Sixteenth street is also under way.

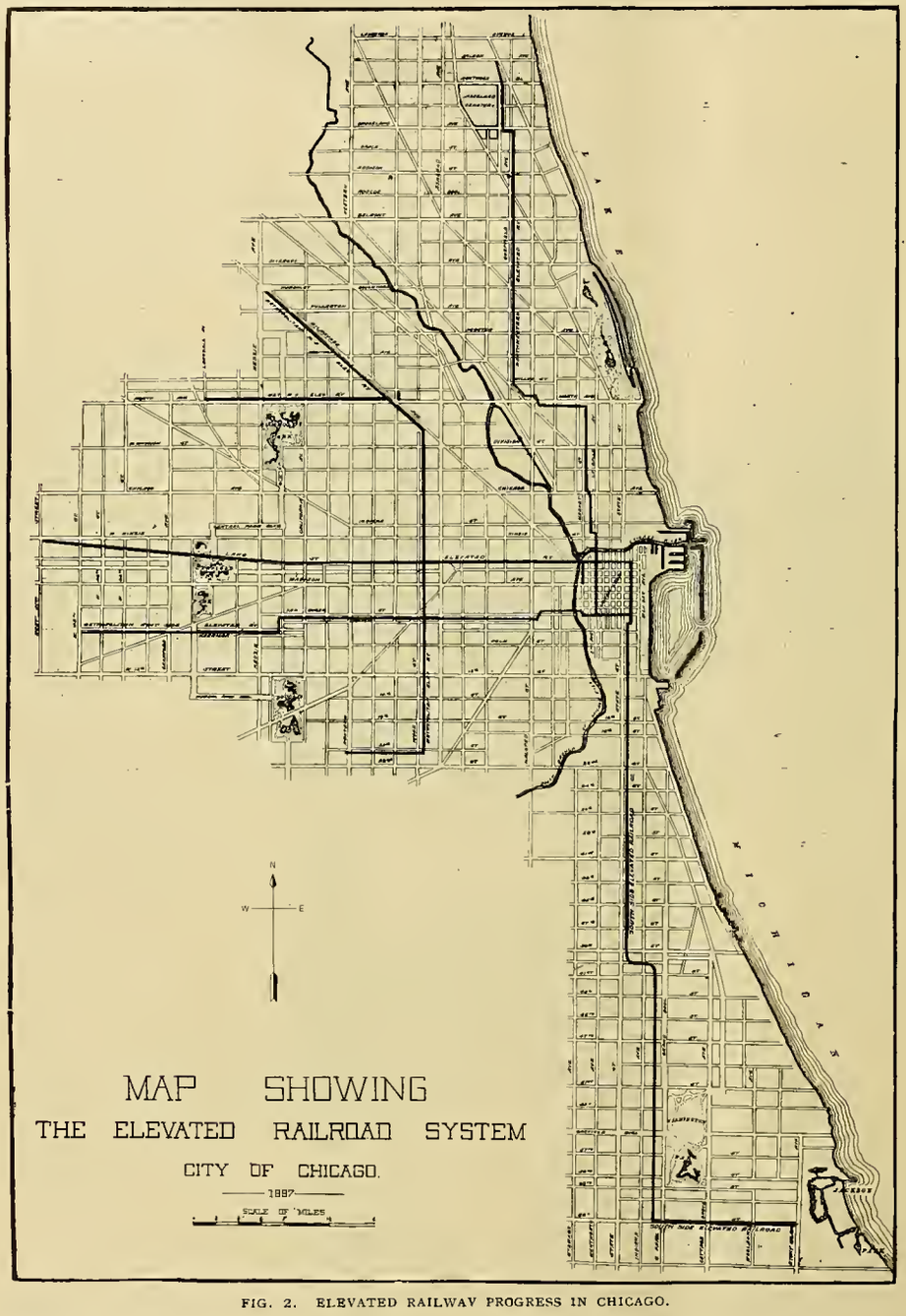


FIG. 2. ELEVATED RAILWAY PROGRESS IN CHICAGO.

The street railway companies of Cleveland, O., have submitted a proposition to the City Council, offering to sell six tickets for 25 cents, give universal transfers and pay a percentage of gross receipts into the city treasury in return for extension of franchises for 25 years from date of renewal, which will extend existing franchises from nine to 14 years. This offer is the result of a vigorous agitation for lower fares made pending the passage of an ordinance reducing fares to four cents on one of the Cleveland lines as a test of the city's rights.

The Use of Acetylene.[1]

By A. H. Mulliken.

Acetylene is a pure hydro-carbon gas, chemically known as C_2H_2. It is clear, colorless, lighter than air and has a specific gravity of 0.91. It contains 92.3 parts carbon and 7.7 parts hydrogen. It has a strong odor, like garlic, except when burning. It has no effect upon iron, steel or brass. It is a chemical union, and when produced, is always the same. It is always to be depended upon, and is as reliable as the law of gravitation.

Pure acetylene will not explode. It is only explosive, like ordinary city gas, when mixed with air in a room, if lighted; but as acetylene burners are never more than one-fifth the size of other gas burners, it will take five times as long for acetylene to escape, if a burner is left open; and, therefore, it is only one-fifth as dangerous as city gas. To quote from Prof. John H. Long: "Acetylene is an exceedingly stable substance, and not at all prone to spontaneous decomposition, such as occurs in nitroglycerine and some kinds of gun cotton, for instance. The gas itself is as stable and safe to handle as common illuminating gas. To cause an explosion with it, the presence of air or oxygen is necessary." Acetylene will not explode in the same manner as gasoline or kerosene. Not being a liquid, it is less liable to the accidents which daily occur with these two illuminants.

After most careful experiments, it has been found that acetylene is not poisonous and does not change the character of the blood, like ordinary gas. Although it is evidently not made to breathe, yet it is a fact that all of the men employed at our Appleton carbide plant who had chronic catarrh have been entirely cured; and, as stated by some of our most enthusiastic agents, the medical rights are free to every purchaser of carbide.

Acetylene will burn (this is a point on which insurance men are all interested); but it will only burn under certain conditions, and these conditions, at the present time, are such that I do not know of a single loss having been paid on a fire caused by the use of acetylene as an illuminant. From an insurance standpoint, acetylene reduces the fire risk wherever it replaces oil lamps and gas machines.

Acetylene is produced by the action of water upon carbide of calcium. Calcium carbide has the chemical formula CaC_2, and contains in 100 parts, 62.5 parts calcium and 37.5 parts carbon. The oxygen of the water combines with the calcium of the calcic carbide, forming oxide of calcium; the hydrogen of the water unites with the carbon, producing acetylene.

Calcium carbide is manufactured from ground lime and coke in an electric furnace. One pound of good commercial carbide contains five cubic feet of acetylene gas. About 20 tons of calcium carbide are now being manufactured every 24 hours in the United States, which will produce 200,000 cubic feet of acetylene, equal, theoretically, in illuminating power, to 6,000,000 cubic feet of ordinary city gas; and, in actual use, to about one-half that amount.

I believe that acetylene will take the place of kerosene and gasoline, but it will not drive out all other forms of illumination, as is sometimes claimed for it; it has its place, and will find it, and will do its share in lighting the world.

The electric light, when it first flickered into existence, was considered at least an improbability, if not an impossibility. It is said that Thomas A. Edison used to walk up and down every night in front of the first house he lighted with electricity, until the lights were extinguished, for fear that the house would burn down; and I am sure that any insurance man present, if his own house were wired and lighted by electricity in the same way as that first building, would be a good deal more scared than was Edison. When the incandescent lamp appeared it was condemned as impracticable; it is now used almost everywhere, and there is hardly a town in the United States but that has its electric light plant.

We have become so accustomed to the convenience of the present illuminating methods that we forget the difficulties encountered by those who made them a success. Ask any man who has been connected with the manufacture and introduction of illuminating gases, if it was an easy thing to do, and he will assure you that he never would go through it again.

Acetylene, compared to the slow growth of the ordinary illuminating gas and electricity, has really made rapid progress.

Acetylene light is the most beautiful light in the world, excepting only sunlight. It has been rightly called "artificial sunlight." The light is pure white; it burns with a steady flame, more brilliant than ordinary gas or electric light; its rays diffuse to a greater extent than that of any other known illuminant; all colors are easily distinguished by its light; and its effect in the room is very much like that of the sun. At the present time it is used principally for isolated lighting, and largely in towns and villages that are not supplied with either ordinary gas or electric light.

Carbide is placed in a generator which automatically furnishes acetylene, when the gas is lighted at one or more burners. For the protection of the public, the insurance companies and the business, the design and construction of the generator, as well as the materials of which it is made, are of the greatest importance. Two years ago there was not a single generator on the market, and three years ago no one knew anything about acetylene generators. What we know to-day is from practical experience, and from an expenditure of money and time. There was, and is, no school in which to study the science of acetylene. It has been impossible to find a professor of facts in regard to carbide. It is a new thing, and, like most new things, it has been injured by irresponsible men who would say anything to make money, and without any regard for the future, here or hereafter. The standing of men in all established lines of business is always considered, but it is a curious fact that in new enterprises, where the field is untrodden, we are one and all as green as grass, and while admiring the new sensation forget to inquire about the character or previous history of the exhibitor.

Acetylene, however, as a business, is being established, and in a business way. The tin-can generator man has nearly passed; the inhabitants of the city, as well as the country, have made his acquaintance, and are now convinced that it was the "feller" who "stuck them," and not the light. I regret that this education of the masses attends almost every new thing, but as shown in this business it appears inevitable.

Acetylene has not yet been used through mains in lighting large towns or cities. As far as I know, there is no reason why it cannot be used in this manner; and I understand that this will be attempted within the next six months.

At the present time it is the country, and not the city, which is using acetylene. The farmer, in this "dawn of prosperity," is not only enjoying "dollar wheat," but also the best light in the world. To-night, in the state of Illinois, more than 200 farmhouses will be lighted by acetylene; and as the wheat of the farm finds its way into all the homes of the country and becomes the "staff of life," so, I be-

1. Abstract of paper read before the Fire Underwriters' Association of the Northwest, at Chicago, September 30, 1897.

lieve, will the light from acetylene, starting on the farm, pervade all of our towns and cities, and its brilliance be enjoyed by everyone, and become the "staff of light."

The history of artificial light shows that it has never been produced without trouble, expense and delay. Acetylene is no exception to this rule; the law of progress is still in force, and rules the universe to-day, as when the divine command went forth, "Let there be light."

Death of E. H. Arnold.

The sad news of the sudden death of Ernest Howard Arnold, superintendent of the Mazatlan (Mexico) Gas and Electric Light company, on September 24th, was received in Chicago last week by his brothers, B. J. and W. L. Arnold. No definite information regarding the cause of his death is known here yet, except such as was given by a dispatch to the effect that it was a contagious fever. Full particulars are expected by mail. Mr. Arnold left Chicago on October 6, 1896, on his 27th birthday, to take the position he was filling at the time of his death, and as he was in good health the last time he was heard from by letter, the telegraphic news of his death and immediate burial is a severe shock to his family and friends.

Mr. Arnold was born at Ashland, Nebraska, October 6, 1869, and after finishing at the high school went to St. Louis, Mo., where he was engaged in electrical construction work for the Southern Electric company for about one year. The school year of 1890-91 he spent at Hillsdale College, Mich., afterward returning to St. Louis, where he was employed by the Thomson-Houston Electric company on the work of the Cass Avenue and Fair Grounds railway, the Benton and Bellefontaine railway, and the St. Louis and Suburban and Missouri railways. He was electrician for the Southern Hotel company for nearly three years, and after the cyclone in St. Louis was employed by the St. Louis and East St. Louis Electric Railway company to reconstruct its work during the recovery of the superintendent, who was injured by the storm. Mr. Arnold had a natural aptitude for electrical work. He was of a generous and loyal nature, and has left a record of duty well performed. He was unmarried. Besides his mother, Mr. Arnold is survived by eight brothers and one sister. He was the fourth son and the first to die.

12,000 Ampere Dynamo Switch.

Modern electrical apparatus for low-tension distribution is so little like its prototype of a dozen years ago that it is sometimes interesting to make comparisons between the practices of to-day and those in vogue during the earlier history of the low-tension electrical industry. In the case of switches used for controlling low-tension dynamos, the example of the switch illustrated herewith certainly shows a marked development from the plug switch used in the early days of electric lighting.

This instrument is one of a set of dynamo switches recently designed by J. J. Van Vleck, and constructed by the General Incandescent Arc Light company of New York for installation in the Duane street station of the Edison Electric Illuminating company of New York, and is probably the largest low-tension switch yet constructed; it consists of two switches mounted on one base, each being intended for insertion in the neutral conductors from a pair of 800 kilowatt dynamos. The normal current-carrying capacity of both switches combined is 12,000 amperes, although the switch can carry, without undue heating, at least 16,000 amperes.

The extreme length of the switch, over all, is 46 inches and its width is 12 inches. The switch is mounted in a horizontal position, as shown, and in addition to its function as a switch, it serves as a base-plate for supporting the well-known Van Vleck edgewise apparatus, in which the dynamo-regulating quadrants are mounted directly on the upper surface of the copper conductors, and in this way the entire apparatus forms a comprehensive mechanism in which a width of only 12 inches is required to operate a pair of 800 kilowatt generators.

The current enters the cable lugs at the lower right-hand end of the device; it then passes through the blades and clips and finally out at the rear connection, shown at the left of the switch; this rear connection being designed to take the terminals of copper shunt, used in connection with the large pattern edgewise Weston amperemeters.

In addition to the main blades and clips, there is mounted on the side of each switch the Donshea field-charging mechanism, which enables each dynamo to be charged from the bus, on starting up, but in shutting down it automatically converts each machine into a self-excited dynamo, thus doing away with the objectionable features connected with discharging a field of large capacity.

The main conducting parts of the switch are constructed of pure wrought and cast copper, finished all over, which parts are mounted on marblelized slate.

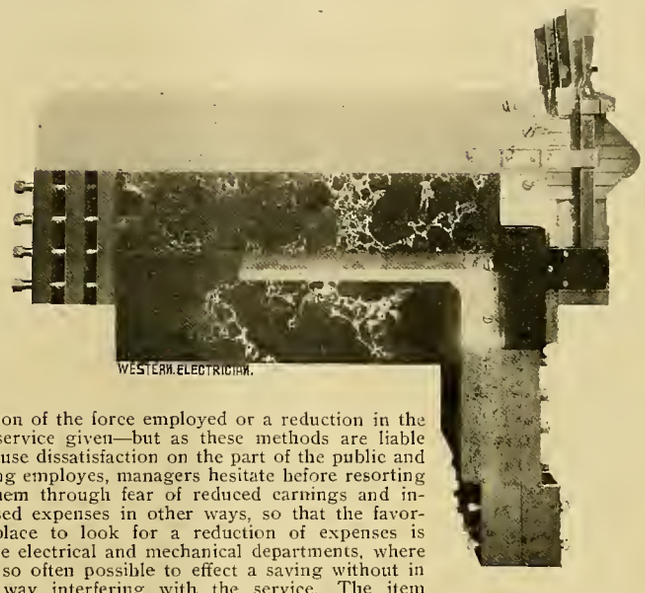
The weight of the device is 1,800 pounds, which shows an interesting increase in size over the primitive plug switches, used a dozen years ago, which were mounted on wood and which, for a pair of dynamos, would scarcely weigh over five pounds.

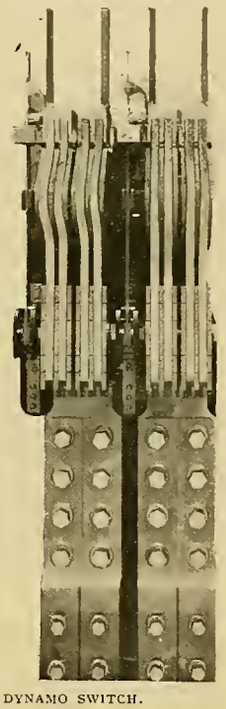
The manufacturer of this switch was also the maker of the switch mechanism used at the Duane street station of the New York Edison company, which is, perhaps, the most notable switchboard in existence, on account of its being constructed on the Van Vleck edgewise system, which permits of the control and distribution of 150,000 amperes in a space not exceeding 40 feet in length.

Economy in Electric Car Control.[1]

By J. R. Cravath.

As electric railroading grows older and one by one the more serious difficulties which hamper operation are disposed of, the electric railway engineer is enabled to give his attention to economies and improvements that have been heretofore unthought of. With some roads apparently the only object of the management is to keep the cars operating, regardless of what the expense may be; but the competent manager is always on the lookout for changes and improvements that will lessen the cost of operation without interfering with the service. There are obviously many ways to reduce operating expenses—by a reduction of salaries, a reduction of the force employed or a reduction in the car service given—but as these methods are liable to cause dissatisfaction on the part of the public and among employes, managers hesitate before resorting to them through fear of reduced earnings and increased expenses in other ways, so that the favorite place to look for a reduction of expenses is in the electrical and mechanical departments, where it is so often possible to effect a saving without in any way interfering with the service. The item of motive power usually forms only a small part of the operating expense of a road, yet a reduction here involves less risk of loss in other directions than reduction in most other departments.





12,000 AMPERE DYNAMO SWITCH.

The most fruitful sources of loss in power and repairs heretofore have been inefficient power plants, poor return circuits and motors and controllers of early design not suited to railway work. There remains one chance for economy about which very little has been said, and that is at the controller handle. When electric roads were a novelty and it was often difficult to keep enough motors out of the repair shop to operate the road, some managers perhaps realized the necessity of getting motormen to handle their controllers properly. To-day on the majority of roads there is a waste of power by the motormen that is well worth considering. To get a car over the road on time with a minimum of energy drawn from the power plant requires the exercise of considerable skill, care and intelligence on the part of the motorman, which few of them will exercise as long as there is no incentive to do so.

Before going further let us analyze the matter of electric car control and see where the losses through carelessness may occur. On nearly all electric roads the service is of such a character as to require frequent stopping and starting. If a motorman could operate his car from one end of the road to the other by simply putting his controller handle full on and leaving it there, obviously there would be no chance for either waste or economy; but frequent stops and starts make it possible in practice to waste power in several ways, principally by turning on current too rapidly in starting, and using an unnecessary amount of energy in the brakes.

To operate a car or train between two stops in a given time we may adopt a variety of methods, as shown by the speed curves A and B in Fig. 1. The curve A shows a quick acceleration and low maximum speed, while B shows a slower acceleration and higher maximum speed. Since distance covered is the product of speed multiplied by time, the area inclosed by such speed curves represents the distance covered. The area inclosed by A and B is the same, hence the service performed is the same in the two areas. That the theoretical energy required in curve A is less than in curve B is evident from the fact that the energy wasted in the brake shoes in stopping the train is equal to

$$\frac{\text{mass} \times (\text{velocity})^2}{2}$$

according to the law of accelerated bodies; which means in this case that with curve B the energy destroyed by the brakes must equal one-half the square on the line X, X, while in the second case the energy wasted in the brakes is half the square on line Y, Y. Thus the theoretical ideal economy would be secured were we able to accelerate and stop cars in an infinitely short space of time, as we could then perform the same service with lower maximum speeds. It might be concluded then that the greatest economy would be secured by accelerating as quickly as possible and stopping according to the same principle; and so it would were we able to operate an electric road under ideal conditions, which, unfortunately, never exist in practice. The difficulty in carrying out this theoretically correct method of operating cars is that, when we attempt to get rapidity of acceleration beyond a certain point we give rise to a number of sources of loss which more than make up for the gain that results. Quick acceleration is a desirable thing, but there is a limit beyond which we cannot go without loss, and it is the constant tendency of motormen to overstep this limit and turn on the power too fast for the best efficiency.

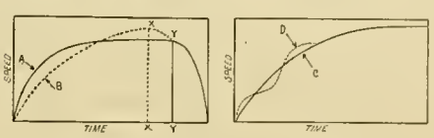


Fig. 1. Fig. 2.

ECONOMY IN ELECTRIC CAR CONTROL.

The theoretical amount of energy required to accelerate a car from rest to a given speed is the same whether that power be applied to start the car quickly or slowly, but practically there are elements which enter into and modify this considerably.

The loss in the electrical conductors in the circuit (this includes power house generators, feeders, trolley lines and ground return) varies according to the square of the current flowing. Thus, the motorman who uses the heavy starting current, even though he uses it for a proportionately shorter time, consumes more energy to get his car up to speed than the one who draws his power at a slower rate. For example, let the time of acceleration from zero to a certain speed be seven seconds and the current used during that time 100 amperes. Then, by the formula, watt-seconds= (current)^2×time in seconds×resistance (the resistance being assumed at .2 ohm, corresponding to 20 volts drop); the watt-seconds lost in line and generator equals 14,000. If, however, a current of 50 amperes be drawn for 14 seconds through the same line to give the same acceleration the loss is 7,000 watt-seconds.

But this is only one item. When a car is equipped with series parallel controllers, according to the best general practice, there is another chance

1. Read before the Chicago Electrical association, October 1, 1897.

for waste of power in starting by throwing motors in multiple before they have had opportunity to attain nearly their full speed when in series. When the motors are in series the torque per ampere drawn from the line is double what it is when they are in multiple. Now, it is torque per ampere that determines the efficiency of the motors as car accelerators. Consequently, to get the full benefit of the efficiency of a series-parallel controller as a car accelerator, the full use must be made of the series combination of motors. Up to half speed the series parallel controller affords a means of accelerating a car with but half the current required by a plain multiple controller, but if a motorman skips over the series points and into multiple with scarcely a pause, he is throwing away half the power he uses during a part of the process of acceleration, and the car might as well be equipped with the old wasteful parallel controller.

Very many motor equipments are now provided with a shunt around the field coils, which is intended to be cut in to weaken the fields, to increase the speed after the full speed has been attained by the motors with fully excited field. The common practice of motormen is to cut in this shunt when the motors are already groaning in an effort to start the car. Weakening the fields at such a time, of course, lowers the torque per ampere that can be obtained from the motors, and consequently the efficiency. It may also be mentioned that since energy lost in heating the motors is proportional to the square of the current, the larger current used with the quicker start not only heats them more and endangers the insulation, but sometimes very materially lowers their speed and efficiency.

It has been maintained by some that the resistance should be cut out as rapidly as possible in starting, in order to avoid the loss of energy in the resistance. While it is true that it is possible to waste energy by continuing to keep in resistance after a car has attained speed on a point, the unnecessary waste of energy in resistance during actual acceleration is more imaginary than real; first, because it is hard to find a man who will keep it in too long if the timetable is as fast as it should be, and, secondly, because a little mathematical calculation shows that the resistance introduced during acceleration is a necessary loss which cannot be eliminated by too rapid controller handling. Let c^2 r t=loss in rheostat and motor resistance during any brief interval of time during acceleration. Suppose now the resistance be reduced, say, one-half, with the result of doubling the current and dividing by two the acceleration produced during the time. Then

$$(2c)^2 \times \frac{r}{2} \times \frac{t}{2}$$

equals loss in second case, whence by elimination $c^2rt=w$, just as in the first case. However, very slow controller handling is not to be recommended any more than very quick, because as soon as the car has responded to any one resistance point on a controller the loss in the resistance begins. An exact analysis of this action is a complex mathematical problem which it is not necessary to enter into here.

Before leaving the subject of losses liable to occur in acceleration, I must mention a mechanical loss which has not been investigated very thoroughly as yet, but which observation leads me to believe is very extensive on all large roads. I refer to the slipping of wheels when starting. An electric motor gives such a steady torque that slipping of wheels is not very noticeable except by close observation. It is unnecessary to say that the energy so expended in wearing out wheels and rails does no good.

The opportunities for a motorman to save power by allowing the car to "drift" with current off, thereby utilizing the energy stored in the car at the time of acceleration, are evident even to the layman. When a car has been brought up to speed it has a momentum which must be destroyed by the brakes as soon as the car has to stop. The less energy, therefore, a motorman has to destroy in the brake shoes in maintaining a certain schedule time, the more economical he is as a car operator. The amount of drifting he can do depends, of course, on the schedule and the traffic, but under conditions as they exist to-day a great deal of energy is wasted in the brakes unnecessarily.

I have so far considered this subject mainly from the standpoint of energy or watts consumed per car-mile. There are, however, other considerations which are fully as important as the average power consumption in some special cases. When all the motormen on a road are habitually using excessively large starting currents the maximum drain on the power plant is such as to require the running of more generating apparatus to provide for the maximum load than would be necessary with a more careful set of motormen, and more feeders are necessary to keep down the fluctuations in voltage.

Still more important than this, in some cases, is the desirability of keeping down repair bills due to abuse of motors by motormen.

To make this paper complete I must refer briefly to the tests that have been made in various ways from time to time by different men, which demonstrate the opportunities for economy by a reform in the common methods of controller handling.

The commercial effect of too rapid turning on of current in starting a car is well illustrated by the results of a number of tests made by G. W. Knox, electrical engineer of the Chicago City Railway company, in 1895, which have since been corroborated. As they have been published several times I will not reproduce them here. In one set of tests the controller was put at the top notch in four seconds and 307,176 watt-seconds were used in acceleration, speed being attained in 9½ seconds. In the other series the controller was put at the top notch in 10 seconds and 221,676 watt-seconds were used in acceleration, speed being attained in 12 seconds. The maximum drop in voltage was 80 in the first case and 20 in the second. Now, since in city service, according to good authorities, the energy used in acceleration is about 75 per cent. of the total energy used by the road, it can be seen how important a bearing it has on the total power consumption to properly handle the controller in starting so as not to waste power. It will be seen that an economical start does not necessarily mean a very slow one, but simply that it requires a little care in advancing the controller.

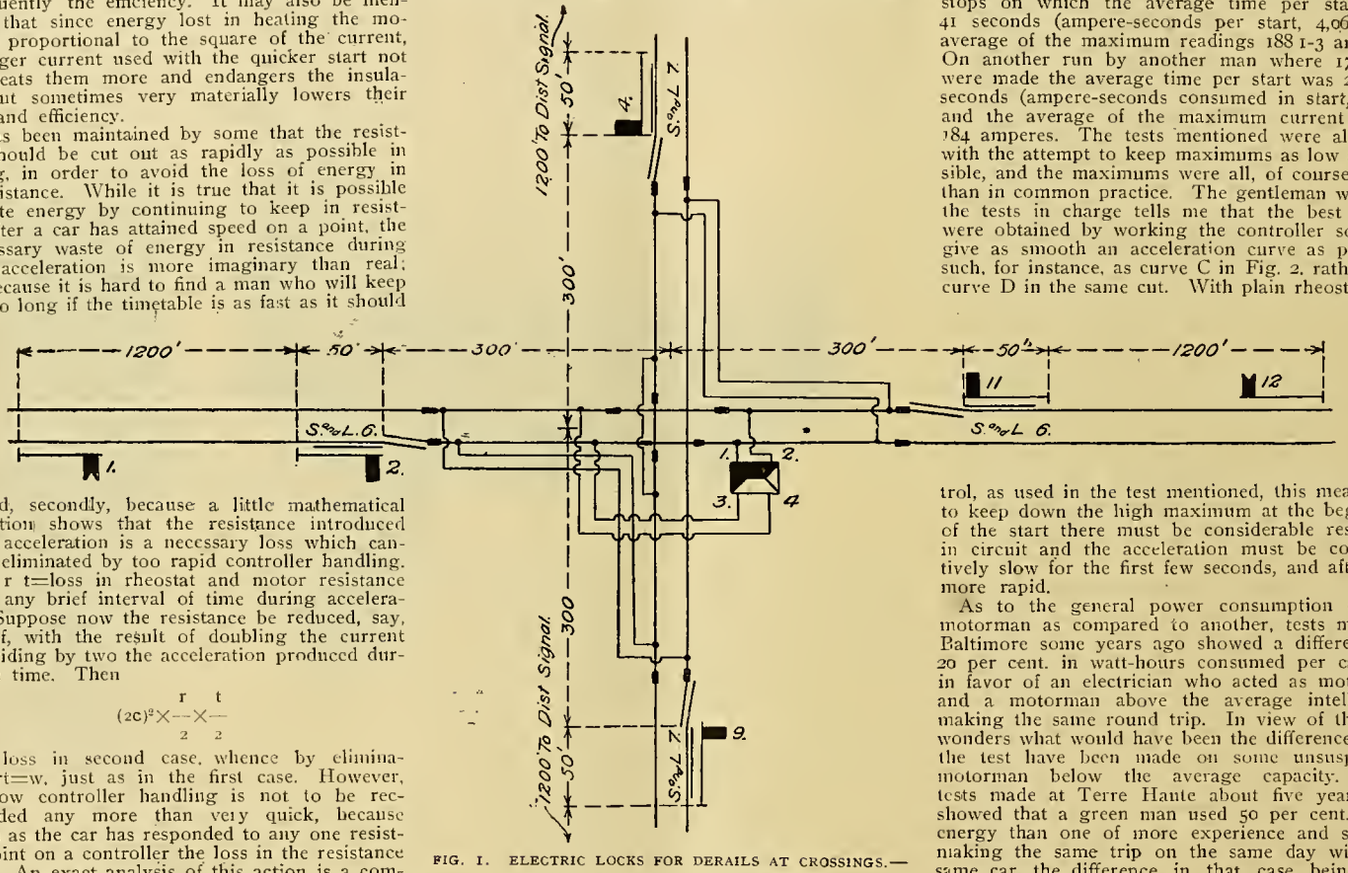


FIG. 1. ELECTRIC LOCKS FOR DERAILS AT CROSSINGS.—APPLICATION AT GRADE CROSSINGS.

A Chicago road which is equipped with a device designed by the writer to check the use of excessive starting current by motormen recently made a saving in coal of 15 to 20 per cent. in performing exactly the same service by the use of the instrument, and also reduced the maximum load at the power house about 25 per cent. This resulted from keeping an individual record of excessive current consumed by each man and showed the difference between care and carelessness in controller handling.

As showing the difference between men and methods of acceleration I may mention some tests I have in my possession which were made by the officers of a road operating a very heavy class of electric service. They were made with a view to determining the best way of operating the particular type of controller used on that road, so as to start trains with the smallest possible maximum current consistent with a fairly fast schedule, and also to determine within what limits the maximum current taken by a train could be kept so as to reduce as low as possible the maximum drain on the power plant and the heating of motors. The tests made covered simply train acceleration. Readings were taken at two-second intervals from the time each start was begun until the ammeter indicated that full speed was reached. Three men were employed in the test, one to read the ammeter, one to put down readings and one to call time. In one set of tests eight consecutive starts were made by a regular motorman, who was one of the best on the road and was doing his best to make a good showing. Plain rheostat control was employed. The maximum currents he used varied between 300 and 210 amperes, the average of the maximums of the eight starts being 262.5 amperes. The average ampere-seconds used per start were 6,814, and the average time per start 54 seconds. This was thought to be a very good record and, indeed, it was, as compared with the practice of many men on the road, but on the same trip and under the same conditions another man who had been able to give the matter a more intelligent study took hold and made six consecutive starts averaging 50 1-3 seconds per start, with maximum currents ranging from 200 to 160 amperes. The watt-seconds used per start averaged 5,794 and the average of the maximum currents used was 185.

Tests on the same road, including 129 starts with a somewhat lighter train, all tended to confirm the conclusions from the results of the tests just mentioned, viz., that to maintain the schedule of the road higher maximum starting currents were being commonly used than there was any necessity for and that the men using the highest maximum starting currents did not necessarily get the quickest or most efficient acceleration, the contrary very often being the case. Thus I notice one run with 12 stops on which the average time per start was 41 seconds (ampere-seconds per start, 4,063) and average of the maximum readings 188 1-3 amperes. On another run by another man where 17 stops were made the average time per start was 25 11-17 seconds (ampere-seconds consumed in start, 2,931) and the average of the maximum current values 184 amperes. The tests mentioned were all made with the attempt to keep maximums as low as possible, and the maximums were all, of course, lower than in common practice. The gentleman who had the tests in charge tells me that the best results were obtained by working the controller so as to give as smooth an acceleration curve as possible, such, for instance, as curve C in Fig. 2, rather than curve D in the same cut. With plain rheostat control, as used in the test mentioned, this meant that to keep down the high maximum at the beginning of the start there must be considerable resistance in circuit and the acceleration must be comparatively slow for the first few seconds, and after that more rapid.

As to the general power consumption of one motorman as compared to another, tests made at Baltimore some years ago showed a difference of 20 per cent. in watt-hours consumed per car-mile in favor of an electrician who acted as motorman and a motorman above the average intelligence making the same round trip. In view of this one wonders what would have been the difference could the test have been made on some unsuspecting motorman below the average capacity. Some tests made at Terre Haute about five years ago showed that a green man used 50 per cent. more energy than one of more experience and skill in making the same trip on the same day with the same car, the difference in that case being due mainly to the waste of energy in the brakes.

Let us now see how a motorman should apply correct principles in the actual operation of a car over the road so as to get the best all-around economical results. In the first place, in starting a car he should pause after each notch long enough to let the car run nearly up to speed on each notch. This does not mean that he should wait until he can detect absolutely no further increase in speed, but he should at least wait until he feels that the motors have responded to the movement of the controller. This will prevent slipping of wheels, jerking of passengers and the use of excessive current. He should be especially careful not to throw from series to multiple until the motors have attained nearly their full series speed. He should also be careful not to move onto a field shunt point before the motors are speeded up on the previous one, or he will waste power and strain armatures. He should always remember that the car should never be accelerated up to full speed when no time is to be gained by doing so. For example, it is very common in city service to see a man run his car up to full speed just before coming to a team on the track and then slowing up by hard braking just behind the team and wait several seconds for it to clear the track. He gains no time by such a proceeding and the energy used in running the car up to speed is immediately wasted in the brake shoes. In running up behind teams at full speed when it is seen that they will not immediately clear the track, he should shut off current some distance back and let the car drift until the point of obstruction is reached. It is a good general rule to shut off current and drift with brakes off as long before making a stop as is consistent with the schedule time. It is a poor plan

to make too gradual stops with the brakes. Let the car drift as fong as possible and then apply the brakes hard enough to make a moderately quick stop. In this way the high speed is maintained for a longer time than when the brakes are set very lightly for a long time, and consequently better time can be made with less power. On down grades use the current as little as possible. It will save work with the brakes and power also. All unnecessary stops should be avoided.

The anthor does not wish to pose as an advocate of snail-like operation of cars, but he does wish to point out the fact that the controller handling

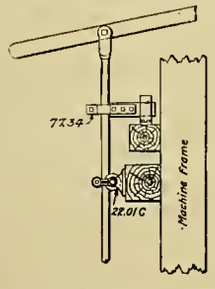


FIG. 2. ELECTRIC LOCKS FOR DERAILS AT CROSSINGS.—CIRCUIT BREAKERS.

on the majority of large city roads is such as to cause a power consumption out of proportion to the results that might be obtained with no change in schedule. The schedule of 99 out of a 100 roads is so fixed that a man can maintain schedule time without violating any of the correct principles spoken of. I believe in fast schedules. It is the way to make a road earn money and the way to please the public, but some means should be provided to require the motormen to do their best to maintain the schedule with the minimum expenditure of energy, and prevent the men from using 1,300 watt-hours per car-mile to maintain a service that others on the same service and same cars take only 1,000 watt-hours to perform, and also to prevent motormen from heating their motors to the breaking-down point.

As long as there is no incentive to proper controller handling it is useless to look for any reform on the part of motormen. They are hut human and will not worry themselves to save something of which no record is kept. Education of motormen is of little use unless there is an incentive to make them apply the knowledge thus acquired. Probably the majority of large roads employ spotters for the purpose of keeping down abuse of motors, but a few hours spent on any large road will demonstrate that the evil is by no means overcome by the services of such men and it becomes a question whether the salary paid them might not better be spent some other way. Looking at the steam roads, we find that they have settled the question as far as their engineers are concerned by keeping comparative coal records for each engine crew, and they find it pays many times over for the clerical labor involved, in spite of the fact that many railroad men laughed at the idea several years ago. The day is soon coming, I believe, when economy will require electric roads to keep comparative records of the efficiency of each motorman, just as such roads are now, for financial reasons, keeping many other records they did not dream of several years ago.

Electric Locks for Derails at Crossings.

Experience has shown the necessity of protecting against the changing of derails or switches immediately in front of a train which is moving at high speed. The arrangements of all properly designed signal plants provide that the signal cannot be clear unless the switch is locked in the proper position; but unless some provision is made to require the signal operator to keep the switch closed after a train has accepted a signal, and until it has passed beyond his jurisdiction, there is always a possibility of throwing the signal back to danger and opening the derail. This danger has been emphasized many times by derailments at high speed, which could not have occurred had the switches been equipped with suitable electric locking.

When interlocking was first introduced into the United States there was some effort made in this direction, but it failed to receive universal commendation for two reasons: First, that the apparatus and installation of the work were very complex, requiring the attention of a skilled electrician to insure its working, and, secondly, the cost was more than the railroads care to incur; and the subject of electric locking was for a time dropped. The frequency of accidents, however, has forced the subject upon the consideration of signal engineers, and the National Switch and Signal company of Easton, Pa., has designed a device which is very simple and does not require the attention of an electrician, as it can be easily cared for by the leverman.

The track circuit between the home and distant signal, formerly used, has been abolished and the only wiring now used is within the limits of the derails. Fig. 1 shows the application of electric locking to a simple grade crossing. The electric lock is applied on the locking frame of the machine in such manner that when the magnets of the lock are de-energized, a bolt is plunged through the tappet by gravity, and in this position the tappet, which in all interlocking machines is actuated by the latch handle on the lever (preliminary locking), cannot be moved, and it is only after the magnets are energised that the tappet is released by the withdrawal of the bolt.

The electric lock has a cone-shaped armature which reduces the necessary battery to a minimum and assures accurate working of the lock. There can be no sticking of the armature on the poles of the magnet, since they do not come in contact The four home signal levers have circuit breakers on their vertical rods. The circuit from the tracks runs through the track relay 74.03 (Fig. 3). Having installed the system as shown, the operation will be as follows:

In order to pass a train over the crossing the operator must first close the derails on one track by throwing either lever 6 or 7, and the throwing of either lever locks the other in the opposite position. The interlocking provides that the derails on both tracks cannot be closed at the same time. Having thrown (reversed) lever 6 and closed the derails, the operator desires to pass a train from left to right and reverses home signal lever No 2. The act of reversing this lever de-energizes the lock magnet by means of a circuit breaker 77.34 (Fig. 2) and causes its plunger to drop into the tappet, holding it as before described.

But putting this home signal lever " home" again would not release the electric lock, as the circuit once broken the armature (74.01) has fallen and broken the circuit, so that until this relay has been re-energized the armature cannot be lifted nor the circuit restored.

As soon as the first pair of wheels reaches the

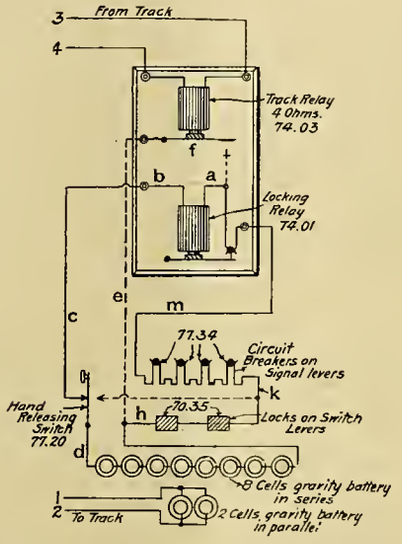


FIG. 3. ELECTRIC LOCKS FOR DERAILS AT CROSSINGS.—ELECTRO-MAGNETS FOR TRACK CIRCUIT SWITCH LOCKING.

track circuit inside the derails the armature of the track circuit 74.03, falls, completing the locking circuit through a, b, c, d, e and f, and energizing the locking relay; but the locks are not moved, as most of the current passes around them, owing to their greater resistance. When the train has passed out of the track circuit and therefore out of the derail limits, the track relay is re-energized, lifting its armature and forcing the entire current to pass through the locks by way of a, b, c, d, h, k, m, re-energising them and withdrawing the plunger from the tappet, provided the home signal has been restored to its normal position (Fig. 3). If it is not restored the circuit cannot be completed. It is necessary for the operator to return the home signal to danger before the train has passed out of the limits of the derail or else the operation of the locking relay will be ineffective and the operator will find that he cannot place the derail lever (6) normal so as to pass a train on the other track.

This might also occur in case a train which was approaching the home signal (2) under a clear signal should be stopped before reaching the derail and remain there while a train on the other track desired to cross. In order to avoid the tying up of the signals in such a case a release switch, 77.20, is provided. This switch is inclosed in a box having a glass face which the operator has to destroy before he can operate the releasing switch, and since he is required to report all such breakages it forms a check against the unnecessary use of the releasing switch. Experience has demonstrated that while this releasing switch should be provided for extreme cases it is very seldom used.

The application of electric locking is, of course, not confined to simple grade crossings, but is found very desirable in the most complex interlocking plants, and especially where a drawbridge is to be protected.

It will be noticed that no crossing (detector) bars are shown in the plan. Special note should be made of the security of substituting the rail circuit, which furnishes the same measure of safety as if the crossing bars were extended from derail to derail; the track between derails must he entirely clear before the opposing route can be set up. It will be seen that by using the rail circuit a protection not possible with crossing bars or any mechanical means is furnished; and, in considering the cost of applying electric locking the cost of the four crossing bars necessary at a single-track crossing must be deducted.

The reason for showing detector bars at the derails is to cover the remote possibility of the operator being able to split a train when the electric lock fails to control the derail lever. This is very remote, as the electric lock acts by breaking circuit, and since gravity is always present it works continually on the safe side. The illustrations are reproduced from the Railroad Gazette.

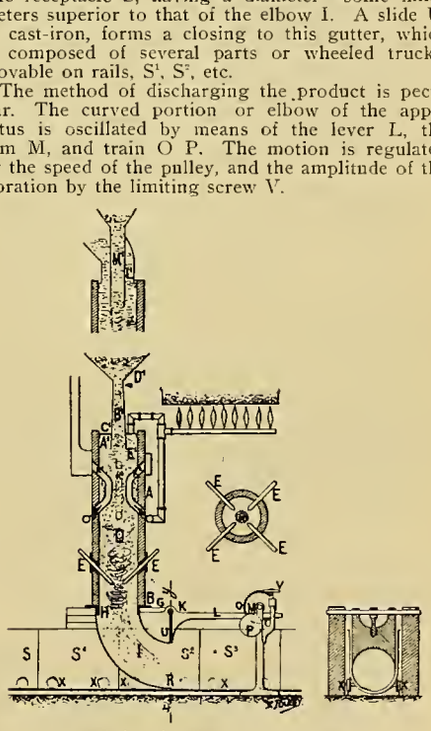
Lelièvre's Electric Furnace.

Since Moissan gave to the world the result of his investigation of the electric furnace, and more recent experiments have led to the discovery of carborundum and the carbide of calcium, the attention of inventors has turned to electric furnaces, of which good, bad and indifferent examples have appeared.

One of these is that of Lelièvre of Tours, France, which is described in L'Electricien.

The furnace, as shown in the cut, is charged through the funnel D^1 and the continuation B^1, which leads a short distance below the cover C^1. That portion of the diagram above and separate from the main body is another form of feeder, which comprises a tube within a tube. The material is introduced through the central passage M^1, while the outlet tube carries the carbon to the furnace, its passageway having the same diameter as the furnace. The two, ascending at the same time, are not mixed; the first is melted in the center of the cylinder formed by the second, and the two are separated after the mass is cooled down. In this form the outer cylinder forms a sort of shield, protecting the outer wall of the furnace A, which rests on a base G, having an opening the full size of the furnace. The opening here becomes curved, the elbow I being movable around its axis K, of which the extremity terminates in a gutter-like receptacle S, having a diameter some millimeters superior to that of the elbow I. A slide U, of cast-iron, forms a closing to this gutter, which is composed of several parts or wheeled trucks, movable on rails, S^1, S^2, etc.

The method of discharging the product is peculiar. The curved portion or elbow of the apparatus is oscillated by means of the lever L, the cam M, and train O P. The motion is regulated by the speed of the pulley, and the amplitude of the vibration by the limiting screw V.



LELIÈVER'S ELECTRIC FURNACE.

This vibratory action causes a regular and constant dropping of the treated matter into the gutter, from which it is automatically pushed to the right by the action of I, at each oscillation. The little cars are thus filled in turn.

The upper portion of the furnace forms a chamber E^1, which receives the gases from the heated material before their emission by the tube G^1. From here their heat can be utilized as dryers, or they may be condensed if desired; or, they can be made to move a registering counter, and thus record the amount of work done. In the manufacture of carbide of calcium, the gases may be burned, and the heat thus generated used for drying the material, either before or after these are introduced into the furnace. One method of thus utilizing the heat is shown, where several gas burners are drying the material before using. E, E, E, E, shows the arrangement of the current-carrying carbons. There is also shown a section through X Y, giving the detail at that point.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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THOMAS JANSEN.

Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

State of Illinois, County of Cook—ss:
Frank Foster Kenworthy being duly sworn deposes and says that he is a resident of the city of Chicago, in the county of Cook and state of Illinois, and that he is the superintendent of the binding department of the Electrician Publishing company, the publishers of the Western Electrician; that he was present at and superintended the binding of No. 24 of Vol. 20 of the Western Electrician, issued on June 12, 1897, and that there were sent out by actual count 20,000 complete copies of said Western Electrician of the volume and number above specified.
And further this affiant sayeth not.

FRANK FOSTER KENWORTHY.

Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

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Chicago is to be congratulated upon the successful opening of the Union loop for elevated railroad trains. Only one company is at present using the structure, but others will take advantage of it at an early day. The Alley "L" will not wait for the completion of the electrical installation, but will operate its trains by steam locomotives for a short time, thus affording a practical illustration of the superiority of the electric system.

Opposition to the provisions of the Allen law was manifested so strongly at Peoria, during the controversy between the rival street railway companies in that city, that the Central Railway company determined to withdraw its application for a 50 year extension of its franchise, greatly to the surprise of the citizens who had assembled to protest against granting any further privileges. The Peoria company secured a 20 year franchise two years ago, but hoped to gain the full measure of 50 years under the Allen law

"From the wild and woolly West" is a favorite expression in English newspapers, especially in relating some hair-raising incident that is supposed to have occurred in this part of the world. Once in a while our friends on the other side draw their inspiration from reliable sources, but even then they find it convenient to distort the facts somewhat to enliven their pages and make the story palatable to English readers. A case in point is the account of the manner in which an "enterprising motorman" in America, "who thinks that trolley cars can swim, makes no scruple about running over an open drawbridge." According to our contemporary, "the curious point about such incidents is that those at fault appear to be quite ready to take their chances along with the other victims, and the death of one motorman would probably not deter others from equal carelessness" What a credulous people the readers of English newspapers must be.

It is interesting to note the change in sentiment often shown by politicians, and to speculate upon the influences at work. The Massachusetts Republican convention inserted a plank in its platform declaring that "the time has come to restrain the extension of boards and commissions and to promote the rational simplification of many now existing." This is in line with the recommendation that Governor Morton and Governor Flower of New York made to the Legislature of the Empire state. The cost of New York commissions increased from $4,000 in 1880 to nearly a million in 1895. In Massachusetts there are 34 commissions, it is said, invested with large powers, responsible to no one but the legislature that created them, and exercising authority in destruction of local self-government that has a parallel only in the intendants of the old regime. The worst feature is that, like legislatures, they become centers of intrigue and corruption, since they often have valuable privileges to bestow that become objects of struggles between persons seeking them. This change in sentiment in New York and Massachusetts is worthy of attention.

Street railway men have a way of construing the laws to suit themselves, regardless of the wishes of others. Many people have wondered what right a street car conductor has to refuse to take them aboard when they signal properly for the car to stop. It has become customary when street cars become "bunched" to run through to the end of the line, stopping only for those who wish to alight. Sometimes the would-be passenger, upon signaling the approaching train, is given the curt advice to take the next train, and frequently he receives no answer at all as the cars whiz by. A man often attempts to board the cars, thinking that they are about to slacken their speed, and if one comes to harm a jury will make short work of the suit, for he has transgressed the rules of the company in trying to board the cars while they are in motion; and yet cars seldom come to a full stop at any time to take on a passenger. It would be interesting to have a court decision on the point of whether street cars are run for the purpose of making a certain schedule time or to accommodate the people. Some of the Chicago street railway men seem to regard the schedule with awe. A little respect for public sentiment would not be out of place.

In determining the time and place for holding meetings of such organizations as the American Street Railway association and the National Electric Light association, which draw their members from all parts of the country, consideration should be had for the weather to be expected at the season when the conventions are held. It has been the experience of many to attend meetings of these organizations at very unsuitable times and places. The National Electric Light association has wisely decided to leave this matter to the determination of the executive committee, and the American Street Railway association will follow its example next year. The plan should meet general approval.

Municipal ownership was the burden of the song that proved most popular at Columbus, Ohio, during the conference of mayors and city councilmen last week. The movement has undoubtedly gained temporary advantage by the prominence given the discussion of this topic, and no doubt the advocates of the theory will endeavor to convey the impression that the meeting fairly reflected public sentiment. Their position would be much stronger had the leaders at Columbus been men of experience and established reputation. Mayor MacVickar of Des Moines, who posed as the special champion of municipal ownership throughout the meeting, and who was chosen president of the organization, spoke with an air of authority upon this subject, in spite of the fact that there is no municipal plant in the city of Des Moines, and that there is not likely to be one there for some time. Yet Mayor MacVickar will henceforth be quoted as an authority upon this subject by advocates of municipal ownership, although his address merely repeated the claims of those who were interested in securing the establishment of a city plant in his bailiwick. His assertions may prove true or they may be entirely erroneous, but, under the circumstances, no business man would be guided in making an investment or determining the policy of any enterprise he was directing, by views of one so inexperienced.

It is admitted even by those who favor the new idea that many of its most earnest advocates are actuated entirely by selfish motives. They may be influenced by the desire for political advantage or financial gain, in any event the taxpayers' interests are lost sight of. When such rapacious spoilsmen as the Tammany leaders, for instance, advocate municipal ownership in their platform honest men hesitate about joining in such a movement. "We favor municipal ownership and municipal control of all municipal franchises," cries Tammany Hall. The heelers are hungry and thirsty and the prospect of thousands of fat jobs is tempting. Think of the city of New York—Greater New York—with its enormous interests, turned over to a horde of hungry office-seekers of the Tammany stripe.

"No sentiment," said Mayor MacVickar at Columbus, "should be allowed to stand in the way of utilizing these monopolies, although it be at the expense of private gain." Sentiment has nothing whatever to do with the matter, nor has the question of private gain the slightest claim to consideration. The sole point to be decided is a practical one, namely, whether private or public ownership of these monopolies conduces to public welfare, and therefore to private welfare, and not whether municipal lighting plants and street railways are successfully operated in European cities, where politics do not prevail as they do in the United States, but whether they are succesful here. Public sentiment is frequently misrepresented by office-holders, who labor under the impression that they form and direct public opinion, whereas they are merely the creatures of circumstance. Too much importance should not be attached, therefore, to the expressions of local politicians whether they are clothed in official authority or merely aspire to place.

Track Bonding—How Can We Obtain the Best Results?[1]

By H. C. Newton.

The true importance of rail bonding, that is, the really significant factor it becomes in determining the cost of operation of the road, is but indirectly realized, I am inclined to think, by the large majority of railroad men. The dimming of the lights on the car on which he is traveling over his road in the evening is a source of regret to the street railroad manager always, for he realizes that there is something wrong; yet his conclusion generally is that there are some bonds loose somewhere, and his regret, when expressed, is most often for the decrease in the speed of his motors which accompanies the fall in voltage, not for the watts of electrical energy which are being consumed heating up bad track joints.

There is an old formula in elementary electricity which, if kept more constantly in mind by street railway economists, would explain some of the obvious faults in the ground return and the extravagant fuel records which have appeared in some first-class street railway power stations. This formula is that for the energy developed in an electrical circuit. It is expressed variously in terms of the current and voltage of the circuit as CE, in terms of the resistance and voltage as ER, or in terms of the resistance and current as C^2R. All or any one of these expressions may be used to advantage in calculating the magnitude of leaks, but they are all generally overlooked by the so-called practical man when reaching his conclusions.

An equipment consisting of a first-class 600 volt voltmeter and a 250 ampere ammeter, with a motor car and an accurate knowledge of the voltage carried at the station, is all the apparatus and data necessary to determine the quantities involved and to obtain with fair approximation the loss which is going on in the circuit outside of the motors and the generators at the station.

The first factor in the determination, viz., the loss in the trolley line, is, to some extent, a known quantity. You have already, or can figure easily, the resistance of the trolley and the feed, and, by assuming a certain volume of current, the amount of energy lost, varying, of course, with the power consumed, is at once arrived at. The second factor must be obtained by the subtraction of the determined factor from the total loss. For this total loss your instruments come in play, and it is only by a series of readings on them with the car in motion on the road, and the determination thereby of the watts spent in running the motors, that a satisfactory result can be obtained. The difference between the voltage as shown on the voltmeter and the volts shown on the voltmeter at the station, multiplied by the current, gives us this result. The difference between this result and the loss obtained for the trolley and trolley feed lines by calculation should give us the loss in the track of the power employed for that individual car. The result is generally astonishing, especially if the traffic is heavy; and there are cities not a thousand miles from here, where the sun of the horse-car rail is not yet set, where reading will show 50 and 60 per cent. loss at certain times.

To obtain the best results a rail joint should have an equal or better, a greater current-carrying-capacity than the body of the rail itself. We have all heard this theory advanced before, but we are all bound to acknowledge that we have never seen it put in practice without it was on a new piece of electrically welded track, on which the joints had not had time to break. Yet every city has portions of track through which a congestion of traffic and a consequent piling up of cars are forcing such a volume of current as to lead to serious power losses therein. The engineer will possibly remember of specifying a No. 0000 copper bond at the time the last piece of nine-inch girder was laid in the congested district, and of congratulating himself on thus getting what he thought was a first-class job of bonding. And yet when he comes to consider that that rail has probably nine times the current-carrying capacity of the bond itself, and the bond is only riveted or upset in some way in the hole in the rail, and instead of having six times its cross-sectional area in contact with the steel of the rail, it has possibly two, he will perceive that there is some reason to doubt whether he has such a first-class job after all.

A waterworks system which was so laid out that 10 per cent. of the power at the station was spent in overcoming friction in the mains would not be regarded with much favor. On the same principle, a street railway system on which a similar percentage of the power is lost in the rail should hardly be considered as a perfect example of electric railroad practice. Yet I will venture the assertion that there are not more than a score of roads in the United States to-day that can prove a more satisfactory condition of affairs. The trolley feeder systems are carefully calculated, but the rail is bonded, how little or how well is immaterial, the ground will take care of what slops over.

With all due deference to the ideas of the track man, whose greatest glory is in a perfect roadbed, and to those of the electrical engineer, whose hobby is a complete trolly feeder system with a theoretical loss of five per cent., I must yet insist on the importance of the rail return. Down in Syracuse we use the soldered bond with no track feeders on the permanent way. The bonding is of No. 0000 capacity and double throughout. The congested district of the city, the common center, is not (as it should be) bonded to equal the capacity of the rail section. Our financial backing has not been educated to that extent as yet and would regard such an outlay as extravagance. The whole track, however, is in such a condition, where the above-named bond has been used, that a low-reading voltmeter has failed at any time to detect a difference of potential between water pipes and rail, and the Western Union Telegraph company, with its keen nose for electrolytic action, has been unable to locate a drop between its lead-covered return and the iron of the rail, the attempt being made with an instrument reading to .01 volt.

The importance of a true metallic return cannot be overestimated. Where the chance for corrosion between bond and rail is allowed to remain the certainty of an interrupted contact one day is assured. The jar produced at the joint by the impact of the car wheels results in vibration enough to loosen fish-plate bolts, and in the natural course of events must loosen rivets as well.

The rail should be one mass of continuous metal throughout to give permanency of electrical contact. It must therefore be homogeneous. To make it so some process of brazing or soldering must be adopted. The former process has been found impracticable except in cases where it is possible to take advantage of welding currents, or return currents of immense volume. These can be obtained ordinarily only at the power station, or by a large expenditure for special welding apparatus.

With these considerations in view the conclusion is forced upon us that the really practicable process is to solder the bond to the rail. Experience has proven it economical in first cost, and most desirable in the character of the results obtained.

The current-carrying capacity or the number and section area of the bond conductors should depend upon the location of the track, many and large for the crowded districts and at the points where the great volume of return current flows before entering the return feeders to the power house, of smaller number and capacity in the outlying districts.

With these provisions for perfecting the ground comes as a matter of course freedom from electrolysis and water and gaspipe corrosion, and a saving in overhead negative feed lines, which should be of immense importance in the design of the permanent system.

1. New York State Street Railway association, Niagara Falls, N. Y., September 15, 1897.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the Western Electrician.]

The prospects are that there will soon be about 3,000 telephones in use in Des Moines, Ia. The Iowa Telephone company has 1,000 in use now, and claims 500 new subscribers as a result of lower rates, while the Mutual Telephone company has 500 instruments in use, 500 to be added as soon as the switchboard can be put in place, and many new orders. There is a war to the death between these companies and prices have been cut deeply. Members of the Grocers' association have signed an agreement to use only the Mutual instruments, and other tradesmen threaten to boycott the Iowa company. Rumors are that the latter has offered yearly service for $18, but this is denied by the Iowa company's manager.

An independent telephone company is an applicant for a franchise at Ottumwa, Ia.

The Wisconsin Bell Telephone company invited the council of Chippewa Falls, Wis., to visit Oshkosh and Milwaukee, to examine the company's exchanges in those cities. The Bell company is sparing no expense to induce the council to refuse the franchise to J. E. Keelyn, of the Western Telephone Construction company. The council, however, on its return, granted the franchise to Keelyn.

The Willmar, Minn., Telephone Exchange company has put in an exchange at a cost of $3,000. There are 78 instruments in use.

Rushford, Minn., now has telephone connection with Winona, Minn.

The Rocky Mountain Bell Telephone company's new building in Helena, Mont., is about ready for occupancy.

The Wisconsin Valley Telephone company expects to have toll-line connection between Minneapolis and St. Paul and Winona, Eau Claire, La Crosse, Stillwater, Hudson, Menomonie, Ashland and Superior.

The Western Telephone Construction company expects to extend its lines through Thorpe, Wis., soon.

The Pepin Telephone company contemplates running a line between Alma and Mondovi, Wis.

The Wisconsin Valley Telephone company proposes a line from Eau Claire to Madison, with a branch to Marshfield, and one east to Green Bay. If sufficient interest is taken, the line will be built this fall.

The City Council of Butte, Mont., gave the street railway company permission to shut down the cable until June 20, 1898, without forfeiting its franchise, to permit it to make changes in its tracks. The company contemplates building an electric line next year.

Advantages of Car Mileage Record.[1]

By T. J. Nicholl.

In the wonderful evolution which the application of electricity as a motive power has everywhere wrought in urban and interurban transit, it is not surprising that street car companies, in the creation of new and adjustment of old departments, important to the new order of things, should possibly have failed to give some matters the attention they demand.

We believe that in the radical and rapid development which has taken place, the subject of mileage is one of the details of the street railway business that has not received the attention or discussion which its importance merits. In fact, it is almost impossible to find an article in reference to the same in any of our railway magazines, and we rarely hear the matter brought up for discussion at railway conventions.

At one time all that was considered necessary was a record of the total mileage made per day on the entire road, and this was kept in a rough way and was only used in figuring earnings and expenses per mile at the end of a certain period. During the horse-car days an estimate, in many cases, sufficed, but the change to electric traction demands a most complete and accurate record, not only of the total daily mileage for the road, but of each route, individual car, the various systems of equipment and trucks, also for the different parts of an equipment, viz., wheels, gears, pinions, armatures, brake-shoes, trolley wheels, etc. In fact, the mileage is the chief and in most cases the best and only basis on which to figure statistics in reference to earnings, traffic, the various operating expenses, etc. In this way it brings every item down to a standard for comparison, and thus proves an almost indispensable guide to economy.

Although, as before stated, the subject has not received sufficient attention, progressive and economical managers are, with the ever-increasing development of electric railroading, realizing more and more the importance attached to a correct mileage record. The tendency is toward greater accuracy in this department in future. We must admit that if a record is worth keeping at all it is worth keeping well, for should a manager make any calculations from statistics based upon an incorrect mileage, he would be liable to entail considerable loss.

With the object in view of having, as near as possible, an absolutely correct system of computing its mileage, this company has spared no effort, with the result that the system now in force works to perfection, and answers our requirements in every detail.

Having been requested to furnish a paper on this subject, we will endeavor to give, as briefly as possible, the system adopted by this road, hoping the same may prove of some value, and furnish some ideas and suggestions.

We operate 78.73 miles of track in the city, covering an area of about 18 square miles. Some of our routes are quite intricate, and on part of them we have as many as six turning points where we can turn part of our cars, as the traffic on the balance of the line may not warrant the same service as nearer the city. In some instances our cars run on several different lines during one day.

Our average daily mileage is between 13,000 and 14,000 miles, or about 5,000,000 miles annually.

In the first place our engineers made a very careful survey of each line, and mapped same out to the scale of 400 feet to one inch. These maps show all switches, cross-overs, junctions, cross-streets, etc., and the distances are given from commencement of the line to all points where it is possible to turn. From these maps we have figured tables for any specified number of trips or half trips in either direction on each route.

Each motorman makes report of the number of trips made by his car daily, on a card which answers a threefold purpose. In addition to giving the number of trips made, it answers as a time card and also as a trouble report.

Any motorman taking out a car makes out one of these cards, which he hands to his relief, and the man pulling the car into the barn drops this card into a box provided for the purpose. The night foreman has access to this box, and from the reports finds out all repairs necessary to be made, and anything he is unable to complete he reports to the day foreman.

Every motorman is advised of the importance of having his trips, time, etc., correct, and is required to account for any trips lost and also to report any defect which he may notice about his car, and if he fails to do so is held strictly accountable.

The trip cards are checked with the starter's report, so that no cards can be left out; also the time of leaving barn and pulling in must agree, and there is no chance of anyone getting more time than is actually put in, as the time a man leaves the car must agree with the time his relief takes it.

From these trip cards the mileage is figured by routes, the mileage for each car being put down separately on the slip.

The individual car mileage is then posted daily to the credit of each car, in a book provided for the purpose, and the amounts are carried forward monthly, so that when we want the mileage of any

1. Read before the New York State Street Railway association, at Niagara Falls, N. Y., September 14, 1897.

article we have only to subtract the mileage at the time the same was put into service from the total mileage made by the car on which it is used, at time it comes out.

The route mileage is posted up daily in a book provided for this purpose, and in this way we get the mileage of each for the month or year; the earnings are also shown on this book.

A daily report is made for the manager, which shows the mileage and earnings on each line, also weather, etc. It also gives the corresponding figures for the previous year.

A monthly mileage, earnings and passenger report is also rendered. This furnishes a comparison between the current and previous year, for each line. It shows the mileage, total earnings, earnings per car-mile, passengers and transfers. It also shows the increase or decrease, as the case may be, and affords an excellent guide in regard to service that should be provided for each line, and we can thus keep each individual route up to a standard. From the figures on this sheet many valuable statistics can be deduced, especially in reference to traffic, etc.

On our monthly mileage statement we figure all the various operating expenses per car-mile, showing also the corresponding figures for the previous year, and thus we have a very good comparison of results. We also keep records of the cost of repairs per mile on the various equipments in use; also of the life of car wheels and other parts of an equipment. In short, from the mileage we obtain most interesting statistics in almost every branch of the business.

To close, we hope the above statement of our experience and system may prove interesting, and that if nothing more it may promote discussion, and bring forward views and suggestions from others, thus giving the subject of car mileage the position to which it is entitled, as a most important factor in street railway statistics.

A 2,500 Horse Power Alternator.

As mentioned in the last issue of the Western Electrician, the great three-phase alternating current dynamo intended for the new station of the Edison Electric Illuminating company of Brooklyn, N. Y., has been shipped from the works of the General Electric company, Schenectady, N. Y. To transport this exceptional generator to its destination not less than five flat cars were needed, and Fig. 1 shows the train with four of them hauled by the General Electric switching engine to the tracks of the New York Central Railroad.

This generator is an alternating current three-phase machine, of the revolving field type, with 40 poles and a normal output of 1,500 kilowatts when running at 75 revolutions. In designing it the instructions, as far as cost and expense of operation, were duly considered in relation to the conditions of service, but the design was left entirely to the General Electric company. The machine which

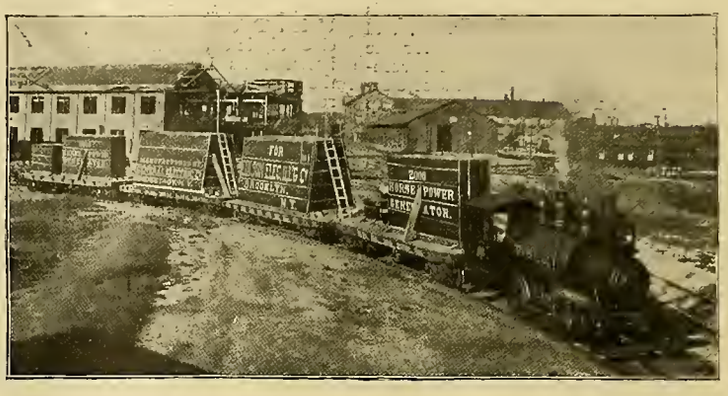


FIG. 1. A 2,500 HORSE POWER ALTERNATOR.—FOUR CARS LOADED WITH BROOKLYN GENERATOR ONLY.

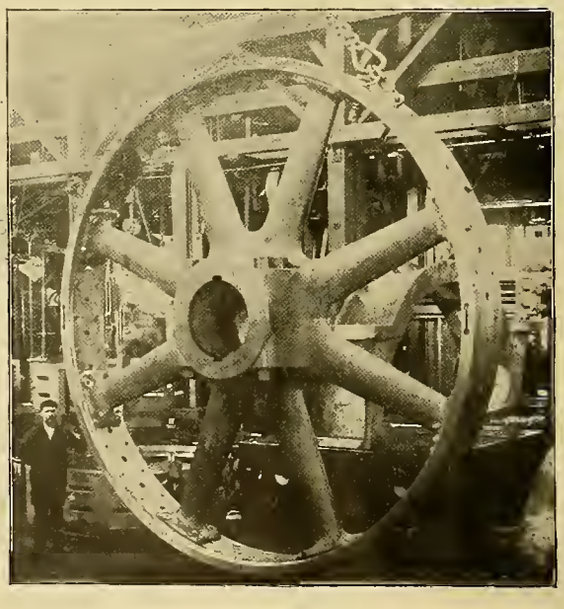


Fig. 3. Revolving Field Frame, Brooklyn Generator.

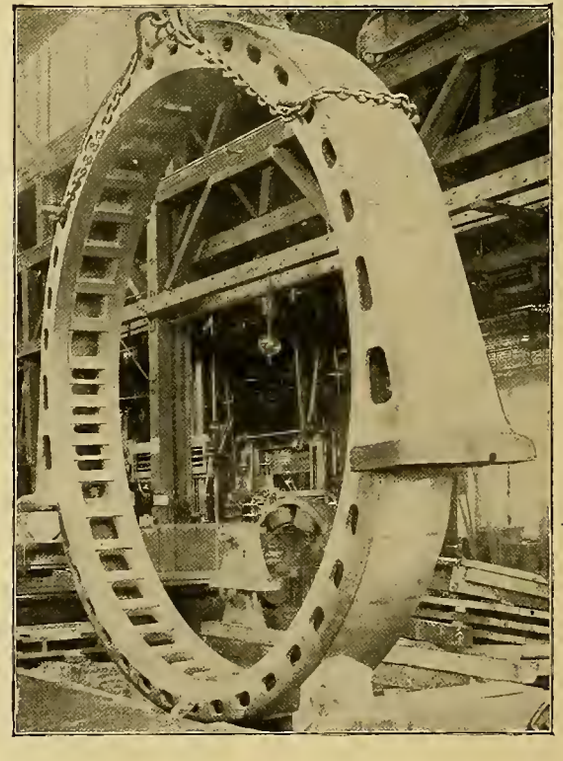


Fig. 2. Armature Frame, Brooklyn Generator.

A 2,500 HORSE POWER ALTERNATOR.

has resulted would, under ordinary conditions, be considered one of 2,000 kilowatts. In use it will be driven directly by an engine giving its highest economy at a little over 1,500 kilowatts, or which may be operated to advantage, and will probably be operated, at an output of 2,000 kilowatts. The engine selected is a four-cylinder triple-expansion engine built by the McIntosh & Seymour company.

The dynamo is wound for an output of 2,000 kilowatts at 6,600 volts. The armature windings are mounted upon the stationary part of the machine, shown in Fig. 2. These windings form one of the most interesting features of the construction of this class of machine, the method of coil construction and insulation being especially adapted to high-voltage work. The armature frame is built to give perfect ventilation to the windings and the machine is guaranteed to operate continually with a heavy overload with only very moderate heating.

Built upon a cast-iron spider, the field structure (Fig. 3) is bolted with a steel ring to the ends of the spokes. To this ring are bolted 40 field pole-pieces, each built up of carefully annealed sheet-iron laminations. Each pole-piece carries a coil made up of heavy copper strip wound on edge. All these coils are connected in series, the direct current used for excitation being carried through them. This field structure will be mounted on the steel shaft, 27 inches in diameter, of the triple expansion engine. On the same shaft are the engine cranks and a heavy fly-wheel, of such weight that the angular variation of speed within each revolution at full load cannot exceed one-quarter of one per cent.

The armature structure will be supported on rails instead of a masonry foundation. This allows the armature to be moved along the rails away from the field, giving easy access to both field coils and armature winding.

The size of this machine, and incidentally, the range of the dynamo and motor work of the General Electric company, may be gauged from the illustration (Fig. 2), which shows standing beside the armature frame a "G E" induction motor of one-half horse power capacity. The dimensions of the generator are as follows:

Span of casting or lower half of amature frame	25 feet.
Vertical outside diameter of amature frame	31 feet 2 inches.
Length along shaft	51 inches.
Weight of revolving field	59,000 pounds.
Total weight	163,000 pounds.

In service this machine will be placed in the new station of the Edison Illuminating company at Bay Ridge, at the entrance to the Narrows of New York Harbor on the Long Island side. It will deliver high-potential three-phase current to a system of conductors, over which it will be distributed at different voltages for many purposes. The territory over which the Brooklyn company is preparing to operate covers over 75 miles; and by the use of a great central station at tidewater, with sub-stations at convenient points, the company proposes to distribute current over this large section. A large portion of the current will be transformed down to 375 volts and then, fed to rotary converters, will be distributed as low-voltage direct current to the Edison three-wire system now receiving current from the stations already in operation. A part of the high-potential current will be used to drive synchronous motors directly coupled to arc machines, as well as to drive other motors for various power purposes. With this source of power supply at their doors, it is expected that the present users of steam power in Brooklyn will avail themselves of the cleaner and more flexible system of drive which the electric current offers.

Dr. Lodge on Electric Traction.

The following communication from Dr. Oliver J. Lodge on the subject of electric railway traction appeared in the Liverpool Daily Post:

"As I see that the subject of the tramways is under discussion, perhaps a few words concerning the successful tram service at work in the cities of Montreal and Toronto may not be inopportune. The power is electric, supplied by overhead wire at safe voltage from a central steam station, not unlike that of our own electric railway; the speed attained by the cars is very high, especially uphill; the starting and stopping are rapid, but free from jerk; the cars are easy of access and are extremely popular; indeed, very little other traffic exists, except wagons by the side of the track and innumerable bicycles, usually on the track and going at a speed similar to that of the cars. The lines intersect the town in all directions, and, by transfer ticket, it is easy to go very quickly from any part of the town to any other by a single payment of fare, the same for all distances. The lines do not stop at the boundary of the town, but run well out into the coun-

try, and thus make many otherwise inaccessible dwellings available for clerks and city men. The hours of running are long, in order to suit all classes of the community, whether for business or pleasure. The cars are light and frequent and airy. They are never allowed to dawdle or rest at either end of their line, but all the plant at work is kept constantly in earning condition. No attempt is made, however, to employ only one set of men. It is felt to be essential that the men shall have all their wits about them, for safe driving on the one hand, for picking up fares in a smart and business-like manner on the other, and accordingly they are only worked in five-hour spells. At present the running is something like this: It begins at 5 a. m., and the first set of men conduct it till 10, at which time a fresh relay takes their place till three; then the first set resumes till eight, and the second set continue till after midnight. The whole thing is said to pay extremely well, and though a few defalcations from the fare-boxes have still to be admitted or suspected, it is hoped by better wages and by general raising the status of the service to remove every important temptation in that direction. This, be it remembered, from the point of view of a dividend-paying company, not from that of a community employing its own members and anxious to set a good example to other employers. The electric power supplied overhead is found beautifully elastic and manageable, easy to adapt to the conditions of junctions and crossings and hills; in fact, the one and only objection to the whole system is that the poles and wires, though not very conspicuous along the tree-shaded avenues which constitute many of the streets in Toronto,

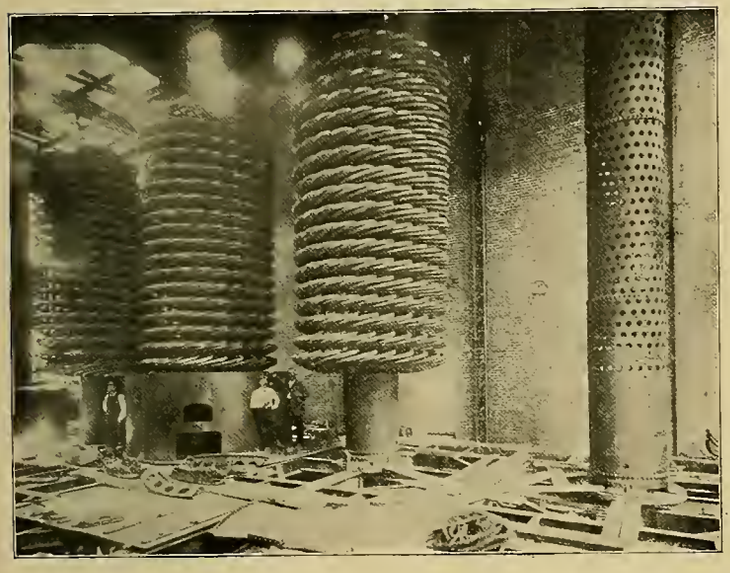
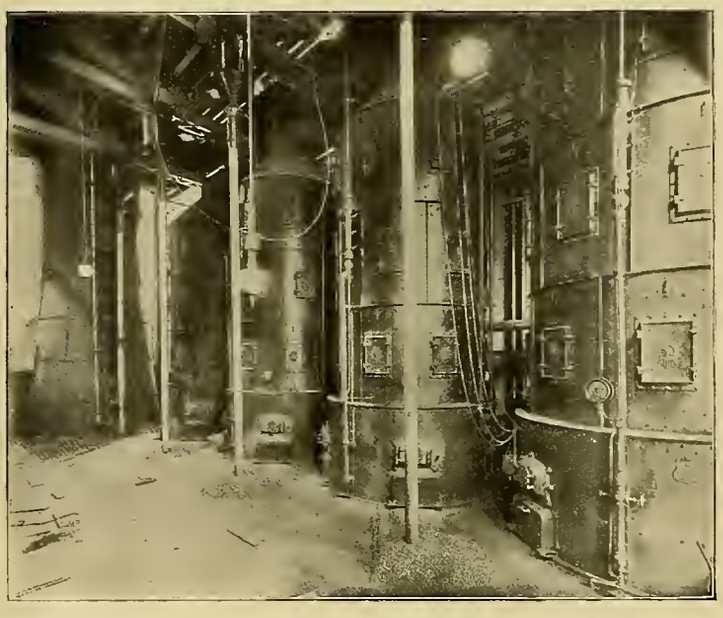


Fig. 2.



CLIMAX BOILERS IN A BROOKLYN LIGHTING STATION. Fig. 1.

are nevertheless to some extent unsightly; but the advantages conferred by rapid and cheap locomotion in a large town are felt to far more than counterbalance this admitted objection. Next to the exuberant and impressive loyalty of the Canadians to the mother country, the thing that most struck the recent British Association visitors was the perfection of their tramway system, and the satisfaction felt with it by every class of the community. It was impossible for an inhabitant of Liverpool not to feel something akin to disgust at the contrast when he remembered the slow and lumbering inefficient and antiquated methods of public street locomotion still prevalent in his own great city."

Climax Boilers in a Brooklyn Lighting Station.

Recently the Clonbrock Boiler Works of Brooklyn, N. Y., completed a battery of boilers in the new plant of the Municipal Electric Light company at Rodney and Ainslie streets, Brooklyn, and the installation is worthy of note, as it shows well the advance in recent years in the construction of steam boiler apparatus. The plant consists of four 450 horse power boilers of the standard type of Morrin Climax. As the construction and erection have been carried out, space is planned for four more boilers of a similar size which, it is believed, will be installed soon. Fig. 1 shows the plant as completed. Fig. 2 shows excellently the two stages of construction of the Climax boiler and the method of arranging the tubes.

By examining this installation, the characteristic features of the Climax boiler may be observed. Those that are particularly favorable for electrical service are these: It has neither screw joints, metal joints, packing joints, cast-iron pipes, manifolds, nor headers to cause trouble from unequal expansion and contraction; there are no large diameters exposed to pressure, resulting in causing the ultimate strength to be far in excess of the strains to which the metal is subjected. A salient feature also of the boiler plant is its compactness. The vent tubes and main shell are filled with water, and the heat circulates in the tubes around the outer shell and vents of the flume, giving a large heating surface in a small space. This method is thought to absorb the greatest amount of heat before it reaches the stack and so lessen losses from radiation. The smokestacks used in the plant were made by the Clonbrock company. They are 175 feet in height, with a diameter of 16 feet at base and 11 feet at the top.

The Significance of the Increasing Use of Water Power.

In considering the rapidly increasing use of electrically transmitted power from waterfalls, the London Spectator gives these statistics: "In America the total of the larger installations is 72,000 horse power, with the prospect of this total being increased to 150,000 when the Niagara scheme is completed. In addition to this there are a very large number of smaller plants in operation in the mining districts of Colorado and Nevada. Switzerland occupies the second place with 32,000 horse power. This will be increased to 48,000 when the second water power plant on the Rhone, near Geneva, is completed. France follows with 18,000 horse power, which will be increased to 30,000 by the completion of the power plant near Lyons. Germany has only one water power of any magnitude, that at Rheinfelden. This will yield 16,000 horse power when completed. Italy has 18,000 horse power; Sweden and Norway between 10,000 and 20,000 horse power each, with almost limitless possibilities of further development, while England and Scotland come at the end of the list with only 4,000 horse power."

The contemplation of these figures is rather disquieting to the London journal, which sees in them a remote possibility of disaster to British industries. The deduction is made as follows: "There is another aspect of this development which is less cheerful for contemplation by three of the nations of Europe. The position which England, Germany and Belgium occupy to-day as the leading manufacturing countries of Europe has resulted chiefly from their possession of extensive coal fields capable of cheap development, coal having been in the past the chief factor in determining the industrial progress of any country. The progress of electrical science has, however, apparently changed the conditions of industrial supremacy, and it appears as though the possession not of coal fields but of water power will be the determining factor in the future. Whether the check to the natural growth and expansion of industry in the older manufacturing countries of Europe, that may already be observed as one result of the increased use of water power in countries hitherto of little or no account in the industrial struggle, will be followed by the gradual migration of the staple industries to the cheaper centers of power, remains for the future to disclose; but it is a question of tremendous significance for the prosperity of the countries concerned. It would involve a rearrangement of the relative position of the nations of Europe, and however pleasant the period of transition and change might be for the nations which would thereby rise into industrial importance, it would most certainly be very much the reverse for the peoples of those three countries of Europe which to-day stand foremost in the extent and number of their manufacturing industries."

The court has authorized repairs to the water power dam furnishing the street railway and electric light plants with power at St. Cloud, Minn., to the extent of $5,000.

Electric Street Railway Repair Shops.[1]

By Robert Dunning.

The equipment of the repair department of the modern street railway is of necessity governed by the same conditions which will obtain in other departments. There is, of course, much in common whether the road be of electric, cable or horse power, but as this paper is limited to the electric railway I will confine my remarks to what, in my experience, has proved to be the most practical for the proper maintenance of the repairs of that style of road.

The repairs of the electric road which operates 12 or 15 cars are, generally speaking, as varied in character as those of a much larger road, but it would be impossible for the small road to maintain a repair equipment equal to that of the large road, as much of the former's repair work must of necessity be done outside. But it is of the larger road I speak—the road which operates from 100 to 400 cars.

In the lists of machinery and tools which I have prepared I have aimed to give only those which are most generally useful as the volume of work increases. Many little conveniences for its quick and easy handling will suggest themselves and can be added to the equipment.

The machine shop, with its auxiliaries, the blacksmith shop, truck shop and armature room, naturally takes precedence in repair work. The value of convenient arrangement of these departments and the proper location of work-benches and machinery to give full working space cannot be overestimated. To find that you cannot operate your speed drill press at times, on account of work in the shaper or planer being in the way, is aggravating and unprofitable. In a factory where new work is being turned out, space may be economized, but in a repair shop you know not what a day may bring in to you. A good rule to observe in this matter is to take as much room as you think you will need and then double it.

A lathe equipment consisting of one 24 inch, one 20 inch and one 10 inch speed lathe will meet all ordinary requirements of that class of work. The larger lathes should be provided with jib crane fitted with differential air pressure lifts for the safe handling of heavy work.

Two large drill presses 22 inches and 26 inches and one speed drill press will do the work of that department.

The other machinery may be listed about as follows:

Good milling machine (not necessarily universal).
Shaper with 18 inch stroke.
Hydraulic wheel press.
Pinion press.
Vertical wheel-boring machine
Axle lathe.
Power shearing machine.
Power hack saw.
Power thread cutter, right and left.
Power punch.
Bending and shaping machines for sheet-iron and tin work.

The grinding work can be done with one dry and one wet grinder, a fine and coarse emery wheel, and there should also be a set of buffing wheels for finishing car and electric fittings.

A babbitting furnace and suitable gas or charcoal stoves are a necessity. The air for blowing these fires may be provided by a tank and pump operated from a special pulley on the overhead shafting.

The necessary vises and hand tools must be ac-

1. New York State Street Railway association, Niagara Falls, N. Y., September 15, 1897.

cording to the men and work, but in the matter of wrenches I prefer the solid jaw fitted to standard nuts, rather than the screw or set wrench. A good arrangement for tools is to have a special tool room in charge of a competent toolmaker and a check system for the purpose of making the workmen responsible for tools drawn.

In the armature room, besides the necessary work-benches and armature stands, a binding machine, a field winding machine and bake oven are essential. A jib crane or overhead trolley with chain falls is necessary for the proper handling of armatures, and a full outfit for testing work completes this outfit.

Have system in the arrangement of work-benches. Keeping the different kinds of work separate, you will thus avoid the delay and trouble of hunting for mislaid pieces.

The truck shop, besides the usual assembling tools, should have an overhead hand-power crane of from 4,000 to 6,000 pounds capacity for the safe handling of motors.

The carpenter shop next claims our attention. The same rules which apply to space and arrangement in the machine shop apply here.

The following outfit of machinery will do for all ordinary work:

Planer.
Resurfacing machine.
Jointer.
Mortiser.
Boring machine.
Shaper.
Wood-turning machine.
Band saw.
Emery wheel.
Grindstone.

A first-class man should be in charge of the machinery, who thoroughly understands the grinding and sharpening of tools, and it should be his work to see that not only the machines are kept in order, but also that tools owned and used by workmen are in proper shape.

In the space devoted to work on car bodies see that there is plenty of room for necessary trestle benches and the convenient handling of work. Pit room for half a dozen cars is a necessity. As a means of moving cars and trucks between carpenter, machine and truck shops, an electric transfer table will be found most convenient.

The paint shop should be constructed so that it will have good roof light, and the width between the tracks should be sufficient to allow the work to be performed on cars standing parallel and not to crowd the workmen; in other words, the gauge lines of tracks should be between seven and eight feet and should be of such capacity as to have the cars pass through regularly every nine or 10 months.

The floor should be of concrete with a smooth surface, so that it would be easily kept clean and free from dirt, and should also be graded to be easily drained.

The power for operating the machinery can generally be best furnished by motors in each shop conveniently located, and so set up as to permit of quick substitution in case of a burn-out or break-down.

Many small repairs which can be done by hand, such as the replacing of trolley wheels, switches, bell or register cords, etc., can be as well done in the car-house proper as in the shops, and result in a considerable saving of time; and I think it well to have tracks set aside for this work and have the conductors of cars instructed to run cars in need of certain repairs onto these tracks when coming into the barn, and to leave a note on file in the barn foreman's office stating repairs needed.

In the whole general scheme of repair work there are minor but yet important parts which go to round out and complete the whole. Among these is the patternmaker, a visit to whose den shows many minute reminders of the transitory state of affairs, even in the street railway business, and the draughting room, where a look through the drawers and pigeon-holes reveals many ideas "born to blush unseen" by the outside world.

The management which has the interests of its road constantly in mind will keep ever closely in touch with the repair department. Do not be afraid of doing too much for it. The fault is generally the other way, for though it works in dirt and as a rubbish producer is unequaled, it is but performing the vital work of renovation and removing that which is dead and is acting as a clog to the whole system.

I do not wish to create the impression that repair work is the one great and vital factor in street railroad economy, but I do wish to claim a high place for it.

Look well to the repair department.

Management of Municipal Plants.

[From the Rochester, N. Y., Post-Express.]

Not a city in the United States can be named where the business intrusted to it is managed with anything like the skill and economy of a sucessful private business. It may be said, as is, in fact, often said, that when gas-works and street cars are in the hands of private capitalists, the public is mercilessly robbed to enrich them. Even if the charge be true, is it robbed to the extent that it is under political management? Does it suffer in like degree from the evils inseparable from politics?

Construction and Maintenance of Car Bodies and Trucks.[1]

By Robert Dunning.

As the life of a car body depends almost entirely upon the bottom framing, nothing but well seasoned and perfectly sound, straight-grained timber should be used. Ordinary kiln-dried lumber is not suitable for car framing, and even when timber has been in the drying shed for a long time it should be given a couple of weeks' seasoning after its first working, for well dried timber will show a slight shrinkage after being worked. Too much care cannot be used in the cutting of mortises and tenons to see that they are tight all the way round and all the way through. The placing of cross sills will be influenced somewhat by the style of car and motor equipment, and there is probably nothing better than strong diamond bracing to hold the frame square. Lead the mortises and tenons, and when the frame is driven together, put in the tie rods, draw up tight and put on corner angle plates and finally square and level up the whole work.

The end and side framing should be assembled with the same care and set up in solid sections on the bottom framing, and lastly put the roof framework in place. Avoid splicing and do not use two short pieces where one long one can be made to do the work. Secure all corners inside and out with light steel angles, and where possible the inside and outside angles should be held in place by the same bolts.

The framing of the platforms should be well considered and made to meet any emergency. The size of timbers will in any case be proportioned to the carrying capacity of the car. The application of the outside covering, inside lining and trimming, should be carefully studied as to its efficiency in the covering of joints and to keeping the frame dry, as well as to its appearance. The main principle to be observed in the whole framework is to produce a combination truss that will offer the greatest resistance to any strain that may be imposed upon it, and the avoidance of the introduction of useless material.

The present tendency in painting is toward simplicity as to colors and ornamentations, and is certainly to be commended from a practical standpoint. The use of a few colors and those that do not fade quickly makes retouching easy and satisfactory and reduces the cost of painting very materially. The neat effect of natural wood finishes in the inside of the car is also to be commended for beauty and long wearing qualities. As to the methods of applying paint, any one which embodies the principle of good materials well mixed, carefully applied and cut down, will produce good results. Nearly every boss painter has some little difference in the method of handling his work, but if he is intelligent and unprejudiced he will produce good results.

In truck construction we have nearly as many patterns as there are life guards, and each makes claims to embody some principle which no other truck has, and all other trucks are therefore fatally defective. With one the great principle of a perfect truck lies in the bearings, with another it is in the frame, another the springs, another the amount of traction, and so on, with additions, subtraction, multiplication and divisions, and the end is not yet. Taken collectively the truck builders have wrought a great work, and when the day comes that produces a truck in which each of the principles they claim is brought to the perfection they now claim in each instance, we can cease our looking for improvement in that direction and reflect complacently that Solomon was certainly mistaken when he said that there was no perfection under the sun. As it is, we must be content with the knowledge that there is one best truck on the market, and though each maker claims it is his, we still have the privilege of choice and can act accordingly, even to experimenting a little ourselves when we feel like exploiting a pet theory. The ideal truck is the one which gives the maximum amount of traction, rigidity of frame, flexibility of operation, ease of running and the minimum amount of oscillation and weight. These and many minor principles go to make the perfect truck. How to attain them is the study of every mechanical engineer in the street railway business and some outside. To enter into a discussion of the principles involved is impossible in this paper, as any one of them would require a long article which time forbids, so we will pass on to the maintenance of cars and trucks.

Perfect maintenance may be described as that which produces the greatest efficiency and best appearance extended over the longest period of time. The method of accomplishing this will differ in minor details under different conditions and service, but the main principles are the same. As to the car body, the words paint and varnish cover nearly the whole subject, and if the car be kept well varnished the question of painting, if well done in the first place, may be set aside for an indefinite time. A car in regular service should be revarnished once in nine months, or oftener, if the locality in which it operates is subject to conditions which are specially injurious to varnished work, such as an excessive amount of smoke and coal gas in the atmosphere. Before retouching and varnishing have the joints of the car inspected, and if any indication of shrinkage or working is shown see that it is put right.

In the truck besides the painting and varnishing, other conditions are to be met, for here the wearing parts demand constant attention and should be gone over every time the car is run into the house. You cannot depend upon the driver or conductor to always report defects, even though they are ordered to do so; their mechanical knowledge may be very limited, and as long as a thing works it is all right to them. In the matter of brake shoes see that the shoe sets true upon the wheel and is in perfect contact on the whole face; through carelessness in truck construction and the molding of brake shoes we often see them worn through at one end and scarcely touching at the other, and again worn in such a way as to show they were set diagonally to the face of the wheel. Test the brake, track cleaners, sanding apparatus and wheels, for you cannot tell what may have happened to them while in operation, and it may mean the saving of life and thousands of dollars to the company if these things are constantly and carefully looked after.

In the matter of flat or skidded wheels, we all know the causes; we also know many remedies for the trouble and have applied them, but the wheels continue perversely to skid, and will probably continue to do so as long as the braking power is applied to them and emergency stops are made. The regular sanding of the track has probably done as much good as anything that has been tried so far, but for the present there seems to be nothing better than to get as high a mileage contract as possible from the wheel maker with the necessary re-grinding included.

To the electrical equipments, all the previous remarks relating to testing and careful inspection apply with double force. The power which is so quick and ready when properly conveyed and guarded will vanish upon the least relaxation of vigilance, and leave disaster in its wake. How to properly care for motors, switches and wiring is also a subject too broad for this paper to attempt to cover, and only a few general points can be mentioned, one of the most important of which is cleanliness. Care in this direction will save many a breakdown, and it is hardly possible to be too thorough. Dirt may be a good insulator at times, but it is scarcely safe to trust it.

Insulation is another point to be carefully scrutinized and the careful and solid connection and securing of the various parts is another. A loose wire if not attended to means damage sooner or later, and a poor connection loss of power, and possible burning. Some companies advocate the taking apart and thorough overhauling of motors and controllers once a month. This would seem to be somewhat oftener than is actually necessary, and it would be an extraordinarily severe service that would require it. The chance of doing damage to electrical apparatus while it is undergoing an overhauling is quite a factor, and it would seem to be more reasonable to use judgment in this matter than to take the apparatus out and put it back at regular periods without regard to other conditions.

The question of maintenance naturally merges into the one of repairs and it is difficult to tell where one leaves off and the other begins. The work of correcting and replacing the thousand and one little things constantly requiring it can only be realized by one who is fully experienced, and fortunate is the road that has efficiency and ability and thoroughness in this department. To say that a street railway company is known by the cars it keeps may be an odd adaptation of an old saying, but it is true, and the road that is thorough in this respect will not stop here, but will keep its other departments up to the same high standard and its reward in nickels will be great.

1. New York State Street Railway association, Niagara Falls, N. Y., September 15, 1897.

Data Upon Municipal Ownership.

During the meeting of mayors and city councilmen at Columbus, Ohio, last week a resolution was adopted declaring that the conference cordially approved of the investigation to be made for the purpose stated by the Hon. Carroll D. Wright, United States commissioner of labor; and that the delegates tender to the United States Department of Labor, and to its duly accredited agents, co-operation in every practical way to facilitate this investigation in the respective municipalities, and to make the information collected complete and accurate.

Arcadia, Wis., has voted bonds for an electric light plant.

Early in the present month the new electric power dam will be used in running the street railway cars in Minneapolis. Two large direct-connected generators are now being put in, and it is the intention at present to start them as soon as they are ready to run. When this is done one of three engines now used at the Second street power station will be laid off. There are to be five high-voltage machines at the dam, three for Minneapolis and two for St. Paul.

CORRESPONDENCE.

New York Notes.

New York, October 5.—After some correspondence between the Rapid Transit Commission and the Park Board in relation to the proposed tunnel under Battery Park, the park commissioners have surrendered and have adopted a resolution approving the plan of the Rapid Transit Commission. Attached to the resolution was a proviso to the effect that all questions of detail in the construction of the rapid transit railroad under streets, parks and public places under the jurisdiction of the Park Department, such as the depth of the road under the surface at any point, its method of construction, its relation to park or other property under the jurisdiction of the Park Department, the damaging of such property by the construction, the periods for which the property shall remain open, and its restoration, shall be submitted to the park commissioners for approval before the construction of the railroad shall be undertaken; also that no such construction shall be begun until the working plans are approved by the Park Board. The Sun asserts that these conditions mean nothing, even if they are accepted by the Rapid Transit Commission, for, it says, it is evident that they cannot be enforced.

In relation to the "calling down" of the Metropolitan Street Railway company for putting in two tracks in Broome street, where permission for only one had been obtained, Mr. Vreeland claims, in addressing the mayor, that the New York and Harlem Railroad company acquired, on May 4, 1838, a franchise to construct a double track in Broome street, between the Bowery and Center street, and has never abandoned that franchise. He goes on to say that under subsequent permission of the Common Council the company has for a long time maintained one track in Grand street, and only one in Broome street. There are now three railroad tracks in Grand street, which occupy practically the entire street, and to remove one would be to the advantage of the business houses which line it. The property-owners in Grand street, Mr. Vreeland claims, are anxious upon the reconstruction of the tracks for the introduction of electric power, that one track should be removed from Grand street and transferred to Broome street. This transfer the company consented to make, not for its own benefit, as Grand street is a better thoroughfare for its purposes, but for the benefit of the public. Mr. Vreeland's letter ends as follows: "This is a matter for the public interest, and not a matter of special concern to the Metropolitan Street Railway company. If the public authorities prefer that we should continue the use of the track in Grand street we can, of course, do so, although we do not for a moment assent to the proposition that we are not entitled to construct and maintain a double track in Broome street."

It is stated that the new Electric Vehicle company will put from 150 to 200 electric cabs on the streets of New York. This big corporation buys out and absorbs the company which has been operating 11 experimental electric cabs in this city. These carriages will continue to be run by the new company, and others will be added as fast as possible.

The new Amsterdam Electric Light and Power company of Brooklyn has at last begun operations, and the Tribune says that a bitter war between electric light companies will, in all probability, be the result. The company had considerable trouble in securing a franchise, and not until the Supreme Court was appealed to did the city grant a franchise to the officers of the new concern. The new company will furnish arc lights for 30 cents a night, or 2½ cents less than is charged by other companies. It is the intention of the company to establish a large plant somewhere in the central part of the city. At present the company has a plant at the end of South Ninth street.

No little interest has been shown in anticipation of the class of telephone apparatus the Smith-Vassar Telephone company of 27 William street, this city, would place upon the market. This curiosity was satisfied on last Thursday when this company invited the public to see its new telephone in operation at its offices. A large number of gentlemen were present, and unusual interest was shown in following the statements made by the various attendants, who explained the radical improvemen's which are claimed for this telephone system, the two strong points being the dispensing of the services of operators at the exchange and the low cost of maintenance of the system by the use of but few wires. The new telephone has a switch with 50 or more numbers on it, and to call a subscriber it is necessary only to put a plug in the hole corresponding to the subscriber's number and turn the switch, when he is called up instantly without disturbing the bells of any of the other subscribers on the line. The present private-line system requires the ringing of all the bells on the line one, two, or more times, according to the number wanted. Under the existing system it is necessary to have two wires from the central office for each subscriber, while the new telephone will require only five or six wires for a hundred or more, the idea being that there will always be a wire not in use. The telephone is switched automatically to this wire, and if all are in use the mechanism is so arranged that it will make a metallic circuit on the first unused wire. It will not, however, cut in on a busy wire. The company intends to begin the use of the telephones in small towns and villages which cannot be supplied with telephones by the Bell company because of the great expense in maintaining the system. The new telephone d spenses with the operator except in a city where 2,000 subscribers are obtained and where 20 sections might be necessary. One or two operators would be sufficient, however, to connect sections. As an example of the difference in the cost of maintenance of a line, 5,000 subscribers under the present system would require 10,000 wires to run into the central office, while under this new system less than 600 wires will furnish the same service, it is contended, with much greater promptness. James G. Smith, the inventor of this system, who is the electrical engineer for the Smith-Vassar company, was for many years a superintendent for the Western Union Telegraph company, and he has been associated with R. G. Vassar in developing this apparatus. The company as organized consists of F. S. Pusey, president; John G. Dorrance, vice-president and general manager; R. G. Vassar, secretary and treasurer. The company has among its directors several gentlemen well known in financial affairs in New York.

A company has been formed with $20,000 capital to conduct an electrical exhibition in 1898 in this city. Articles of incorporation have been filed in Albany, and these gentlemen were named as officers and directors: Cyrus O. Baker, Jr., president; Ferd. W. Roebling, vice-president; George F. Porter, secretary and treasurer. These officers, with Leonard F. Requa, Charles A. Lieb, J. W. Godfrey and H. H. Harrison, constitute the board of directors. The executive committee will include C. O. Baker, Jr., Leonard F. Requa and H. H. Harrison. Marcus Nathan has been selected as general manager.

Some enemy or practical joker played a trick on several brokers in New street last week. Forged notices that the concerns were going out of business and wished their tickers removed were received late on Thursday afternoon at the office of the Gold and Stock Telegraph company. That company at once sent out men who removed the tickers. The absence of the tickers was a surprise to the proprietors of the places when they got downtown. The brokers hurried to the office of the ticker company, where the notices, which they at once pronounced forgeries, were shown to them. Matters were finally straightened out and the tickers were replaced; but in the meantime the market had been open nearly an hour, and, in the absence of quotations, the regular patrons had deserted the concerns and gone to other offices in the neighborhood to place their trades. W. F. O.

From Old Virginia.

Richmond, October 4.—A little drift of sand across the tracks of the North Portsmouth electric railway on South street was the cause of a peculiar delay. The sand broke the circuit; the car came to a standstill and the lights went out. The motorman and conductor thought at first that the power had given out, owing to some accident at the power-house, but when, after a good deal of exertion, they succeeded in pushing the car over the drift, the power was available.

J. B. Crankshaw of Newport News will resign his position as electrician of the Newport News, Hampton and Old Point Railway company, having accepted a position with the Dayton and Western Traction company of Dayton, Ohio, as superintendent of construction. He will make the change this month.

A surveying corps is now engaged in surveying a route from Staunton to North River Gap, for a Chesapeake and Western connection, and it is said to be a certainty that the road will be pushed that far at once. Owing to the numerous mountains and heavy grade to Highlands, there is a prospect that the electric railway project will be abandoned as impracticable, and a road be built from Staunton to join the Chesapeake and Western at Mount Solon and thus get into Highlands. This now seems the only feasible route.

The Richmond Telephone company is getting ready to place telephones in Manchester.

The efforts of the Potomac Lighting and Power company of Washington to get the contract for lighting the streets of Alexandria are not meeting with much success, as the council committee on light and finance will not listen to any such proposals.

The Hampton Electric Light and Power company has sued the city of Hampton for $25,000, to recover damages, which the plaintiff alleges were done to its property in 1892. During that year the city council concluded that the company was not fulfilling its contract, in that it was not furnishing the candle power contracted for in its agreement with the city. After repeated warnings it is alleged that the city authorities ordered all the company's poles cut down. At any rate the town sergeant chopped them down, leaving nothing but their stumps to tell where they once stood. The property thus destroyed is said by the plaintiff to have been worth $9,000.

At the last meeting of the Richmond Academy of Medicine and Science the telephone question occupied the attention of the members to the almost total exclusion of matters professional, and the following resolution was adopted: "Resolved, That it is the opinion of the academy that but one 'phone should be used in the city." It is presumed that the grave and reverend dignitaries meant one telephone company and not one telephone only.

The war recently waged against the Interstate Telephone company of Charlottesville by the new Albemarle Telephone company waxes fiercer. The old company has reduced the price of the service, but the new company persists in establishing its line.

The Richmond Traction company is preparing to begin work on the Exposition grounds to turn it into a pleasure resort to be known as the Electric Park. Y. P.

New England News.

Boston, October 5.—The Board of Railroad Commissioners of Massachusetts gave a hearing recently on the terms of the lease of the West End street railroad to the Boston Elevated Railway company, and after both sides—that is, the promoters and the objectors to the lease—had been heard, the hearing was closed. Of course, whatever opposition there is comes from the outside public, as the stockholders of the West End and the Boston Elevated Railway people are all perfectly satisfied with the terms. The opposition which was heard at the hearing was markedly weak, or to say the least was not very formidable. Now, however, Congressman John F. Fitzgerald of Boston, who is distinguished among other things as being the only Democratic congressman from New England, is out in a letter to the Board of Railroad Commissioners which may possibly result in having the hearing reopened. Congressman Fitzgerald, who claims that he did not know that the hearing was to take place, although the fact was advertised in at least three Boston daily newspapers, represents a constituency which is about as anti-corporation in sentiment as any in the United States. The congressman bases his objection principally to the ratification of that clause of the lease and charter of the elevated company which gives it the power to charge a five-cent fare for a period of 25 years without any restriction. This section Mr. Fitzgerald considers to be outrageous, and, considered with the fact that the West End stockholders are to be guaranteed eight per cent. on their stock, free from taxes, it leads him to believe that the railroad commissioners will never consent to such a "monstrous proposition." While he was a member of the Massachusetts State Senate Mr. Fitzgerald worked hard to secure a system of free transfers on the West End. That was some years ago, and unlimited free transfers seem to be as far away as ever, although a transfer check is granted on some lines of the road. If Congressman Fitzgerald can show that there is a demand that the hearing shall be reopened, the commissioners will of course sit again on the subject.

A remarkable story, which the daily newspapers jumped at the opportunity given to illustrate, comes from Norway, Me., near which the Oxford Central electric railroad is being constructed. The Italian workmen employed on the road, having been unable to get any pay for their services, seized Albert Davis, one of the contractors, and a brother of Contractor Wilson, to hold them as hostages until they received their pay. Two deputy-sheriffs made a successful attempt, on September 20th, to rescue the imprisoned men. The Italians tried to prevent the escape of their prisoners and fired revolvers. The officers returned the fire. One Italian was shot and had his leg broken and one of the officers received a slight bullet wound.

The West End company has completed the chimney for its new power house on Boylston street, Cambridge. It is 226 feet high, and more than 800,000 bricks were used in its construction. The cap of cast-iron weighs six tons. The stack has been provided with lightning-rods made of copper ⅜ inch in diameter, four in number, that are fastened to the chimney by bell metal holds at distances of five feet. Extraordinary care has been used in securing a perfect electrical ground connection. At a distance of 30 feet from the chimney two holes, each five feet deep, were dug, large copper cylinders, filled with charcoal, placed therein and covered. An electrical test has been made with satisfactory results.

Prof. Albert C. Crehore of the scientific department of Dartmouth College, Hanover, N. H., who spent the summer in England with Lieut. G. O. Squier, U. S. N., of Fort Monroe, Va., conducting experiments with the synchronograph, has made announcement of the results attained, which greatly interests the college and which will prove of value to the scientific world. Prof. Crehore says that the experiments were conducted in Europe because the offices there were found to be better equipped with instruments than those in this country. He was accorded the gratuitous use of government wires, and any desired length of uninterrupted circuit was placed at his disposal. All offices along the line of experiment were closed, and Mr. Augustus Eden, a British government engineer, assisted in the experiments. "Our longest wire used was a loop circuit of both copper and iron wire, extending from London to Glasgow, Aberdeen, Edinburg, and back to London, a distance of 1,100 miles, including about 50 miles of underground cable," says Prof. Crehore. "We sent over this long line and received simultaneously messages averaging a speed of over 4,000 words per

minute, 733 waves per second, or 1,446 single impulses. We even carried the experiment to such a degree as to satisfactorily establish the law for the machine in the same way that the law for the Wheatstone instrument is known; that is, with any given wire we can foretell accurately the speed of transmission by the instrument." The electricians are confident that their invention will revolutionize both telegraphy and telephony. They claim that the system will largely supplant the mail service, and by its use it will be possible to transmit matter enough for a whole newspaper in an hour. Experiments by the inventors have also shown that the synchronograph can transmit a message on one line and simultaneously receive another on another wire; also that manifold copies of a single message can be sent by the same transmitter simultaneously and to widely different localities.

In the United States Circuit Court in this city on September 25th, in the matter of the petition of the defendant in the case of W. H. Baker against the United Telegram company for an order restraining the receiver of the company from appearing in the state court with the company's books and papers, Mr. Stockbridge, counsel for the defendant, said that some circumstances had arisen since the trial which made it unnecessary for him to press the motion. Mr. Thorndyke, for Mr. Baker, read an affidavit denying the allegations of the petition so far as they affect him. Mr. Baker denied all knowledge of the action brought against Straine and Lamson in the state court until after their arrest. The court ordered the affidavit placed on file with the petition, and the matter rests for the present.

Frank A. Laws, S. B., instructor in electrical measurements at the Massachusetts Institute of Technology, has been made assistant professor on the same subject. With Prof. Norton he will give a new prescribed course at the Institute this year in electrical and heat measurements.

Section 4 of the subway in Boston was opened to traffic on September 30th. This section was built by the Metropolitan Construction company, the bid being $293,375, and it was one of the first finished anywhere near the time called for in the specifications. The style of construction differs materially from that of sections 1 and 2, in that it is an arch of brick which springs from heavy concrete walls. It is not as roomy or as handsome as the sections now in use, and doubts have been expressed whether or not it will properly accommodate the equipment to be used by the Elevated Railway company. The space between the overhanging of the double-track electrics and the row of incandescent lamps which illuminate the tunnel is understood to be less than two inches, and with an increase in the height of the cars, which would be necessary on the elevated structure, a new problem in lighting the section will have to be met.

The New England Telephone company has begun a long-distance service between Boston and points in Canada connecting with the wires of the Canadian Bell Telephone company. The long-distance service of the New England company extends only to St. Albans, Vt., but in order to make a perfected service heavy wires were strung from Greenfield, Mass., to St. Armand, P. Q., where the lines of the Bell company have been met. The preliminary test of the new service was made by President Sherwin of the New England company and President Hudson of the American Bell company in the Boston office. They exchanged congratulations with President Sise of the Canadian Bell company in Montreal. The service was perfect, and later Quebec and Montreal were connected. The distance between Boston and Toronto is 800 miles, and the service is as good as that of any line for an equal distance. C. S. G.

Washington, D. C.

Washington, October 5.—People are still talking about the great fire of a week ago, which destroyed the power house of the Capital Traction company. It is stated that property worth more than $1,000,000 was destroyed within an hour. The building was constructed after that pattern known as "slow-burning," and yet it was but 20 minutes after the fire broke out before the walls fell in. It is not known that anything except the books and papers of the railroad company were saved. This utter destruction and ruin has seriously crippled the Pennsylvania avenue, Georgetown, Fourteenth street and Navy Yard lines of the company, and the traffic is being taken care of at present by horse cars. While the directors have not absolutely decided, it is almost certain that the cable will not be used again as a motive power, nor are those interested anxious to "monkey" with compressed air, and it is generally conceded by all that the underground electric system will be installed. The company will abandon the site which the power house occupied. This gives credit to the report that the underground electric system will be used in the future, as the company will be able to operate its lines from the new station in Georgetown. Vice-president Glover states in an interview that a first-class rapid transit system will be established. Several tenders of assistance were made by the other railroad companies, business men and contractors to President Dunlop.

The general feeling among capitalists and others who are interested in the affairs of the Capital Traction company is to the effect that the ground on which the old power house stood will be sold. it has increased in value considerably since the company bought it, and it is believed that it would be an excellent move to sell. The building was the largest that has ever been erected in this city by a private individual or corporation, costing over $255,000. The machinery in use was of the best, and consisted of three separate sets of engines, drums and boilers. This triplicate arrangement was thought to be necessary on account of the fact that three lines of cable were run out of the building, one to Georgetown, another to the Navy Yard and a third to Mount Pleasant, and should any one engine become disabled the cable could be quickly transferred to another. Traction company officials state that the machinery cost $600,000 and the building $255,000. After deducting the insurance, an estimate of the net loss would place it at about $600,000. The offices of the company have been moved to the new Union Station in Georgetown, to remain there until final arrangements are made.

The incandescent light circuits of the United States Electric Light company were almost wholly shut off throughout the entire city, as the main line of the wires ran by the burned building. The street lamps were not affected, however, as most of the wires for that service are underground. As soon as workmen could get near enough, a force was set at work running lines of wire around the scene of the fire, again connecting the circuit. This company's loss is confined to the wire and labor of repairing the circuit.

The Baltimore and Potomac Telephone company escaped with much less loss, as but few of their wires were burned outside of those running into the power house. Linemen were at work before the fire had ceased to heat up the avenue, cutting out the dead wires.

The Postal Telegraph company was not disturbed as far as the out-of-town wires were concerned, but the messenger service was greatly crippled. Some of the branch telegraph offices about the city were cut off from the main office, and the repairs will be considerable.

The Western Union Telegraph company had about the same experience. Its local wires were broken, crippling the messenger service and cutting out branch offices.

The station of the Washington, Alexandria and Mount Vernon electric railroad, just across the way from the burned building, was damaged beyond possibility of repair, and the car service was crippled, as the debris is piled 20 feet deep or more on the tracks.

T. C. Schofield, an electrician, who had an office in the building, lost a number of valuable electrical working tools and instruments.

Prof. Berliner, the scientist, had a large and valuable collection of scientific instruments, which was totally destroyed.

J. E. Bromwell & Sons, silver and nickel platers, had an extensive and expensive plating and electric plant. Their stock of plated goods and tools on hand was quite large. The loss is said to be over $1,500; the insurance is not known.

The Baldwin Electric Meter company, whose plant was in the building, incurs a heavy loss, as its tools and machinery were delicate and expensive. Several valuable meters were also destroyed.

T. I. P.

Northwestern Notations.

Minneapolis, October 5.—The five street railway companies of Sioux City, Ia., have all asked for extensions of their franchises, one for 29 years, three for 50, and one for 70, and the people are somewhat indignant over it. Mass meetings have been held to protest against granting the extensions. The requests are based on the statement that extensive improvements are contemplated, which cannot be made unless bonds can be issued, and they cannot be floated on a franchise which does not run a long time. Arrangements have practically been closed by which these five companies are to be consolidated under one company. Heretofore they have all had a hard struggle to make expenses, but with the reduced expenses resulting from consolidation, it is thought there will be profit for them.

L. L. Brown, Wm. Hayes Laird and John Dietze have applied to the council for a franchise for electric light, heat and power furnishing. If granted, they will form the People's Light and Power company, with $80,000 capital stock.

Business men of Anoka, Minn., will wait on the Minneapolis Street Railway company to induce it to extend a line to that city. There is very little likelihood that the company will build it, but if Anoka people will make a proposition to build a line, the question of its operation would be another matter.

The Western Union Telegraph company has protested against the council of St. Paul forfeiting franchises of certain telegraph companies claiming to operate under the franchises of these unknown companies as well as under its own. The companies whose franchises were threatened were the American Union, Mutual Union and Chicago and Northwestern.

The joint committee of the Assembly and Board of Aldermen in St. Paul recommends taking bids for an electric light plant with a capacity of 400 arc lights for constant service and 100 arcs for contingencies. C.

PERSONAL.

J. E. Walsh of the Hodge, Walsh & Loring Electrical Engineering company, Kansas City, Mo., was in Chicago this week.

W. H. St. John has been elected superintendent of the municipal plant for electric lights, waterworks and sewerage of Grenada, Miss.

General Manager Baird of the Eddy company, while in Chicago on Monday, said that there was a marked improvement throughout the East in all lines of business.

Frank J. Sprague, who will apply his system of motor control to the newly equipped cars of the South Side Elevated Railroad company, was in Chicago several days this week.

On October 1st the legal firm of McMurdy & Job, well known to Chicago electrical men, dissolved partnership by mutual consent. Each partner will continue the practice of law.

The municipality of Leghorn (Italy) has erected a monument to the memory of Galileo Ferraris, bearing the date of his birth (October 31, 1847) and also the date of his death (February 7, 1897). The authorities at Rome have also founded a scholarship to perpetuate his memory, which will take the form of a biennial prize for inventions in the application of electricity.

William W. Griscom, well known to electrical men as an authority on storage batteries, was accidentally killed while rifle shooting near his summer home at Minniocoganshene Island, Ont. The death occurred on Friday, September 24th, and on the succeeding Tuesday the funeral services were held at Haverford, Pa. Mr. Griscom was 46 years of age and had been in ill health of late years. A wife and two children survive him.

Albert L. Ide, the well-known engine builder of Springfield, Ill., died at Chetek, Wis., on September 30th. Mr. Ide was a wealthy and prominent citizen of Springfield, where he had resided for many years, although a native of the state of Ohio. He was 56 years of age. In partnership with his son Mr. Ide manufactured the Ideal high-speed engine, which had a large sale for use in electric lighting plants, particulary in the West. Mr. Ide was also president and manager of the Springfield Electric Light and Power company.

The Prince of Naples is said to be an amateur electrician of no mean capacity. It is reported that "his hobbies are of a scientific nature" and that "he is, perhaps, the only real electrician among all the present princes of Europe." He has never occupied himself much with literature, music or painting, but he is said to be a master of electric mechanism, being familiar with all that concerns the application of electricity to light, motive power, sound and photography. He was one of the first and most successful experimenters with the X-rays, and in Rome his residence in the Quirinal had the aspect, during his bachelor days, of a scientific laboratory.

ELECTRIC LIGHTING.

The State Department has been informed by United States Consul Tucker, at Martinique, that the city of St. Pierre has decided to light its streets by electricity, and will grant a concession for 25 years. The city has ample water power to run dynamos. Bids for the contract, which must be made in the French language, will be received up to December 6th.

The Allegheny County Light company, Pittsburg, Pa., has recently installed four very large Westinghouse engines of the vertical, compound, marine type, each driving Westinghouse two-phase 1,500 kilowatt generators. These are the largest steam-driven alternating current machines ever built, and the engines are the largest to which alternating current machines have ever been directly connected.

ELECTRIC RAILWAYS.

Five residents of Chicago have filed in the Lake County, Indiana, Circuit Court damage suits against the Calumet Electric and the South Chicago City Railway companies, and ask an aggregate of $200,000 in damages for injuries received in a collision of cars of the two companies at Seventy-fifth street July 4th.

At Bloomington, Ill., last week the ladies of the city took charge of the trolley lines and the receipts were devoted to charity. Only cash fares were received and the ladies were not always punctilious about returning change. Many fines were paid by those who were detected walking, riding a wheel or driving in a carriage.

On September 20th two ordinances were passed granting an extension of franchise for 50 years to the Omaha and Council Bluffs Motor company and the Lake Manawa Railway company. The charter of neither expires until 1910, yet they sought the

extension before the new laws went into effect, which gives the people of Council Bluffs the right to vote on these questions. On September 30th at nine o'clock the mayor signed both ordinances. As a result there was intense excitement in Omaha and Council Bluffs. Great crowds thronged the streets in front of the city hall, some cheering the mayor, others denouncing his action.

MISCELLANEOUS.

A large party made up of members of the Western Society of Engineers and ladies made an eastern pilgrimage two weeks ago under the direction of a committee consisting of Isham Randolph, W. A. Finley, H. W. Parkhurst, G. M. Wisner and A. C. Schrader. The trip was enjoyed by 190 persons, who inspected the electrical plants at Niagara Falls, the Bethlehem (Pa.) Iron Works, cement works at Coplay, Pa., and Phillipsburg, N. J., the factory of the Ingersoll-Sergeant Drill company at Easton, Pa., the Brooklyn navy yard and other points of interest.

"The term horse power when applied to a boiler is always misleading," says Power, "besides being a misnomer to start with. A hundred horse power boiler will supply steam for a modern engine to develop 200 horse power. The term should be avoided when speaking of boilers whenever it can be gracefully done, and we notice with gratification that an English writer says of water-tube boilers that 'the approximate cost erected is £96 per 1,000 pounds evaporation.' That is to say, you can buy and erect for £96 enough boiler to evaporate 1,000 pounds of steam per hour. You can use the steam in a pump at an expense of 200 pounds per hour per horse power, making the boiler supply five horse power, or in a compound engine at an expense of 13 or 14 pounds, making the boiler supply 70 horse power, or you can use it for boiling glue and generating no horse power at all."

ELECTRICAL SECURITIES.

The Edison Electric Illuminating company of New York has declared a quarterly dividend of 1½ per cent., payable November 1st.

The Brooklyn Rapid Transit company reports gross earnings for September of $478,830, an increase of $27,327, as compared with the same month last year.

The North Chicago Street Railroad company on October 1st declared its quarterly dividend of three per cent., payable October 15th to stockholders of record October 5th.

The Mexican Telegraph company has declared a quarterly dividend of 2½ per cent., payable October 13th. The company reports for the quarter ended September 30th: Gross earnings, $73,076; operating expenses, $16,000; net earnings, $57,076; other income, $7,477; total, $64,553; dividends, $47,815; surplus, $16,738; total surplus, $610,826.

The Central and South American Telegraph company has declared a quarterly dividend of 1½ per cent., payable October 6th. The company reports for the quarter ended September 30th: Gross receipts, $188,161; operating expenses, $75,000; net earnings $113,161; other income, $3,139; total, $116,300; dividends, $115,884; surplus, $416; total surplus, $388,406.

The New Orleans Traction company reports gross earnings for August of $106,958, a decrease of $881 as compared with the same month of last year, and net $26,303, a decrease of $19,620. For the eight months ended August 31st the gross earnings were $865,588, a decrease of $40,089 as compared with the corresponding period of last year, and net $274,132, a decrease of $122,584.

In connection with the recent offering of $300,000 of the bonds of the Chicago General Electric Railway company, with a block of Love Traction stock, at auction in New York, and its subsequent withdrawal, it is now reported that the Englewood and Chicago Electric Railway company is negotiating for the purchase of the stock and bonds and control of the franchise. It would prove a valuable privilege to the storage battery road.

During the week there has been placed on the market $500,000 of five per cent. first mortgage gold bonds of the Michigan Telephone company, part of an authorized issue of $750,000. The price asked is 100½ and accrued interest. The bonds are dated July 1, 1896, and the principle is due July 1, 1917. The sinking fund requirement is that commencing July 1, 1902, the company shall each year set aside $36,000 to be invested in the bonds if they can be had at par and interest. The prospectus accompanying the offer of the bonds says the value of the security covered by the issue as shown by the books December 31, 1896, was $2,574,418.41, represented by stocks and other companies, accounts due and sundries, $450,000; franchise, $110,000; real estate, $226,000; construction, $1,800,000. The net earnings of the company in 1896 were $192,000. The purpose of the issue is to provide funds for extensions, and all property acquired by the proceeds will be subject to the mortgage. The Michigan Telephone company is controlled by the same interests which control the Chicago Telephone and the Central Union Telephone companies. It is the sole licensee of the American Bell Telephone company in the state of Michigan.

The plan of reorganization of the Englewood and Chicago Electric Street Railway company provides for issuing the following securities: First mortgage five per cent. 30 year gold bonds, interest payable January and July in each year, the first coupon payable July 1, 1898, the bonds to be redeemable at 105 on January 1st and July 1st each year, $500,000; consolidated mortgage five per cent. 30 year gold bonds, dated January 1, 1898, interest payable April 1st and October 1st each year, $1,000,000; capital stock, common, $2,000,000; total capitalization immediately authorized, $3,500,000. The mortgage securing the consolidated bonds shall provide that for the first five years the interest shall be payable only out of surplus net earnings, above the interest on the first mortgage bonds, as declared by the board of directors. This interest for the first five years shall not be cumulative. After five years the five per cent. shall be a fixed and absolute charge. Both the first and consolidated mortgage shall provide for an additional issue of bonds above $500,000 and $1,000,000 respectively, to an indefinite amount, to pay for the actual cost of new property and equipment, or consolidated mortgage bonds may be issued to take up first mortgage bonds. The title to the common stock, except such number of shares as shall be necessary to qualify directors, is to be vested for five years in three voting trustees, to be named by the reorganization committee; vacancies among the voting trustees to be filled by the survivors. Until the stock is delivered by the voting trustees to the persons entitled to it the trustees shall issue certificates of beneficial interest. The owners of the $900,000 first mortgage bonds held by the committee are to subscribe for an amount of the new first mortgage bonds equal to 30 per cent. of their holdings of the old bonds, and to pay for them in cash in three installments. On making such payment the receipt holders will receive an amount of the new first mortgage bonds equal to their subscriptions, and consolidated bonds equal to the par of their holdings of old first mortgage bonds and double that amount in new common stock. This arrangement will bring $270,000 in cash into the reorganization committee's hands. The public sale of the property will take place October 12th. The reorganization committee expects to be the purchaser.

TRADE NEWS.

G. A. Hurd, the ubiquitous representative of the Crane company, Chicago, expects to be one of the early arrivals at the Niagara street railway convention in order to have his company's exhibit ready in due time.

For convenience, in view of rapidly increasing business, the Phœnix Interior Telephone company of New York has changed its name to the Phœnix Electric Telephone company, with address at 95 Washington street, New York.

One of the machinery attractions at the St. Louis Exposition is the 100 kilowatt direct-connected Walker dynamo in use in the power house. This generator was sold to the Exposition company by W. R. Mason, the St. Louis representative of the Walker company.

The large number of friends of George W. Conover, Monadnock building, Chicago, will be interested to know that he has been appointed western agent for the Manhattan General Construction company, with office at 1511 Monadnock building. He has also recently received the western agency of the Puritan Electric company, manufacturing the Puritan alternating inclosed arc lamp. Mr. Conover is an enterprising salesman and has made for himself an enviable reputation as a thoroughly reliable and efficient man. The two companies mentioned might have searched a long time and not found one better qualified to take charge of their affairs in the West.

While General Manager Wessels of the Standard Air Brake company was in Europe he noticed that the powerful Board of Trade in London permitted the use of electric brakes on street railway cars in England and Ireland, but there was no reference made in the government specifications to air brakes. He at once took up the matter actively with the secretary, and volunteered to discuss before the Board of Trade the question of the relative merits of air brakes and electric brakes. The members of the board advised him that it was contrary to precedent for them to have such questions verbally discussed before them, but that they would be glad to hear from him in writing on the subject. Mr. Wessels' faith in air brakes is so unbounded that he presented an exhaustive argument to the board, in which he showed how widely Standard air brakes had been adopted in Europe and that they had become standard and were mentioned in all the specifications in Australia. After weighing his arguments, the Board of Trade sent a letter to Mr. Wessels before his departure for America reading as follows: "With reference to your letter of July 8th on the subject of the use of air brakes on tram cars, I am directed by the Board of Trade to inform you that they are advised that there is no reason why an efficient air brake should not be allowed by the department." It will thus be seen that there is no obstacle whatever in the way of Standard air brakes being adopted by any of the street railways in the United Kingdom. The Standard Air Brake company is receiving congratulations.

The automatic circuit breakers, enamel rheostats and other specialties of the Ward Leonard Electric company have become so thoroughly introduced both in this country and abroad that their increased sale has forced the Ward Leonard Electric company to greatly extend its manufacturing facilities, and also provide for its expected future growth, and consequently the company has recently purchased a fine factory plant at Bronxville, N. Y., which, being but two miles north of New York city, is extremely convenient as regards location for the New York city trade. The company has just moved into its new buildings, but everything is already running smoothly. Everything about the plant is of the most recent type, and the company's officers are much pleased with their new quarters. It is hardly possible to conceive of a more efficient manufacturing equipment than this company now has, and it is fair to assume that the move of the company to Bronxville will soon result in still further reductions in the prices of its well-known circuit breakers and enamel rheostats.

BUSINESS.

A pretty picture in colors representing a box of strawberries tipped over is the latest contribution of the Western Electric company.

Everyone desires to keep informed on Yukon, the Klondyke and Alaskan gold fields. Send 10 cents for large compendium of vast information and big color map to Hamilton Publishing company, Indianapolis, Ind.

The Vindex Electric company of Chicago is crowded to its factory capacity making Vindex transformers. These transformers are exploited for high average efficiency, great economy and reliability. A neat little catalogue, sent on application, gives in detail the points of the device.

Supplies for electric lighting, house goods and telephone and telegraph instruments and accessories are listed and illustrated in the No. 9 catalogue of the Manhattan Electrical Supply company of 32 Cortlandt street, New York. This company makes a specialty of open-circuit batteries. The catalogue is sent on application, and dealers can have a discount sheet also.

The covering of pipes and boilers is an important item in the economy of steam plants, and one to which the careful engineer gives close attention. A little book bearing the name "Carey's Coverings" has been issued by the Philip Carey Manufacturing company of Lockland, Ohio, to give information on this subject. All sorts of pipe covering and lagging are described, and a number of testimonials show the appreciation in which the Carey products are held.

The Boiler Expurgator company, 115 Dearborn street, Chicago, sole selling agent of Holm's "Tesoline" commutator compound, is gratified with the success which it has had in placing its product on the market. Orders in dozen lots and requests for samples are being received almost every hour of the day, and flattering testimonials from those who have tried the compound come in daily. The company claims for its product features of unusual merit. Those who desire to give it a trial can obtain a free sample on request.

The Hart switch is one of the standard articles known throughout the electrical fraternity for its excellence of manufacture, and, therefore, it is not surprising that the manufacturing company reports that the call for its apparatus of late has been in excess of that for the same length of time during the last year. The No. 2 box for iron armored conduit with gang of two switches, which is furnished with any number of outlets desired, is also in demand, as shown by the large number of orders that has been received since it was offered for sale.

There are few concerns in the electrical trade whose apparatus is more widely known than that of the Eddy Electric Manufacturing company of Windsor, Conn., and it is, therefore, not surprising that when a return of good business occurs this company should feel it among the first. Secretary A. D. Newton reports that he can see a decided improvement each week in their business, and he and his associates are pleased to note that a large share of the inquiries and prospective future business is coming from the central and western states.

The Electric Appliance company has just issued a new circular on the "Midget" Upton long-burning arc lamp giving a complete description of the lamp in the various styles and types, together with illustrations of complete lamps and the working mechanism. The company reports that this lamp is one of its most satisfactory specialties, as it sells on sight and always gives good results. In construction it is probably the simplest arc lamp on the

market to-day, and, in this lamp at least, simplicity of construction means satisfactory operation. The Electric Appliance company would be glad to send its new circular and make prices on application.

President F. A. La Roche of the Ideal Electric corporation of New York reports that his company has recently completed orders for 20 of the largest switchboards which have been sent out from New York for a long time. These boards were mounted with the company's new perfected knife switches and Keystone instruments. This concern has recently been obliged to add materially to its working force in order to meet the increase of business. The La Roche alternating current arc lamp, which is claimed to run for 75 hours with one trimming and to work on any voltage from 100 to 125, has many strong features; all the electrical energy, it is pointed out, is used to develop light. The company reports large sales in this department, and is looking forward to an increased business.

The Electric Storage Battery company (Chicago: 1543 Marquette building) has closed a contract with the Edison Electric Illuminating company of Boston for a battery of chloride accumulators. This will make the fifth battery in the service of the Boston Edison company. Contracts have also been recently closed for central station batteries with the Cleveland Electric Illuminating company and the Richmond (Va.) Railway and Electric company, and for batteries for regulation on trolley roads with the Central Railway company of Baltimore and the Potomac Electric Power company of Washington. The Potomac company has been operating a battery of chloride accumulators for about a year. A battery is also being installed on the lines of the Barre and Montpelier Electric Railway company, Montpelier, Vt. Chloride accumulators are being installed in the Reading terminal station in Philadelphia to carry the peak of the load and to furnish current for the lamps burned during the early hours of the morning. A battery is being installed in the new library building of Princeton University. This battery is to be charged by the town plant between dusk and midnight, and during other hours will furnish the current required for the lamps and for operating three ventilating motors, two elevators and one book lift. The government has recently contracted for a battery for lighting work at David's Island, and has also ordered something over 1,000 cells to be distributed at various points for coast defense work. Chloride accumulators have been installed in the residence of S. S. Childs, Baskingridge, N. J., where they are being operated in connection with a gas engine and dynamo plant. D. S. Brown & Co., New York, are installing chloride accumulators for night lighting in their new factory.

ILLUSTRATED ELECTRICAL PATENT RECORD.

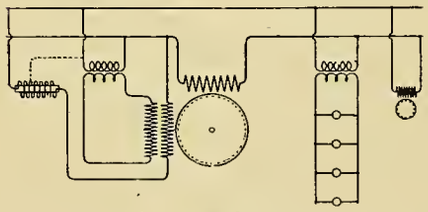
Issued September 28, 1897.

590,589. Electric Trolley Device. Antoine B. du Pont, Detroit, Mich. Application filed January 15, 1897.

A contact-making carriage for electric trolley devices comprising a tubular bearing, a contact wheel mounted thereon, with sides secured to the bearings and rollers secured between the sides.

590,599. Signaling for Electric Railways. Jacob B. Struble, Wilkinsburg, Pa. Application filed January 2, 1897.

A trolley wire extends along the block to be protected, and is divided into two or more sections, each section having a permanent connection to the main feed wire, with magnets forming portions of the connections between the feed and trolley wires, a signal and a circuit controlling the signal, and including as parts thereof the armatures of the magnets.



NO. 590,650.

590,603. Electric Fire-alarm System. John L. Walker and George B. Walker, Pensacola, Fla. Application filed January 12, 1897.

The claim is given: In a continuous circuit system the combination of the main station and sub or signal stations, of an alarm at the main station located in the continuous circuit, a telephone at the main station having means for bringing it into the continuous circuit without a break therein, a telephone located at the sub-station normally out of the continuous circuit, and means for bringing it into the continuous circuit and at the same time signaling at the main station, consisting of a pair of spring arms in contact with each other and located in the continuous circuit, and a plug connected with the telephone formed with a wedge-shaped non-conducting head which is adapted to part the springs to break the circuit, and thereby signal at the main station, and with a metal contact point for again closing the circuit and bringing the telephone into the continuous circuit.

590,633. Telephone System and Telephone Exchange Mechanism. Harlen P. Snow, Erie, Pa. Application filed September 19, 1896.

In an exchange switchboard each outgoing line wire is paired with the return line wires so as to form a circuit; induction coils are in circuit with each of the pairs of wires, and a switch-plug is connected with the secondary of each of the induction coils.

590,648. Recording Wattmeter. William H. Pratt, Lynn, Mass. Application filed May 15, 1897.

An astatic motor mechanism is employed, comprising more than a single armature winding or section of winding which respectively act under the influence of magnetism in opposite directions to rotate the shaft in the same direction, and a damping mechanism.

590,650. Alternating Current Meter. Robert Shand, Lynn, Mass. Application filed March 12, 1897.

This is an induction meter, the principal feature of which is the combination of a current coil, a potential coil, a transformer whose primary is coupled across the circuit mains, and a third coil in the secondary circuit of the transformer, all the coils being in inductive relation to the rotating armature.

590,653. Shielding Device for Electric Meters. Elihu Thomson, Swampscott, Mass. Application filed May 21, 1897.

A moving armature and stationary field coils are employed, with a shield of good conducting material surrounding each of the field coils, a disk carried by the armature shaft, and magnets for damping the rotation of the armature.

590,654. Electric Measuring Instrument. Elihu Thomson, Swampscott, Mass. Application filed June 17, 1897.

A coil is mounted at an angle on a shaft, a second coil at an angle to the first coil and its shaft and encircling the same, the second coil being in series with the first coil, an indicator and scale for reading the movements of the shaft and movable coil, and means for returning the instrument to zero and opposing the movements of the movable coil under the action of the current in the coils.

590,664. Printing Telegraph. Rheinhold Kübler, Berlin, Germany. Application filed September 8, 1896.

A transmitting instrument for printing-telegraphs comprises a base and clockwork, a metallic key supporting ring supported thereon, a metallic contact ring provided with interrupting insulations and insulated from the key-supporting ring, a contact arm revoluble thereon by the clockwork and connected with the main circuit, and a key for closing a local circuit and causing the arrest of the clockwork and arm to control the local circuit and the synchronously operated mechanism of a corresponding receiving instrument.

590,725. Electric Arc Lamp. Henry Leitner, London, England. Application filed April 16, 1897.

A series and shunt coil are placed side by side and wound in independent sections, and a set of contact bars is provided for each coil, each bar connected to a section, with a central iron core in each coil, a frame connected to each core, brushes on each frame bearing on the contact bars and connections from the cores to the carbons.

590,750. Safety Fuse for Electrical Devices. David J. Cartwright, Boston, Mass. Application filed April 19, 1897.

A fuse wire passes through the tube or case; a rod extends transversely through the case and is normally held by the fuse wire when the fuse wire is unbroken, and a spring acting when the fuse wire is broken to cause the projection of the rod.

590,777. Magnetic Brake. William Stanley, Pittsfield, Mass. Application filed July 31, 1897.

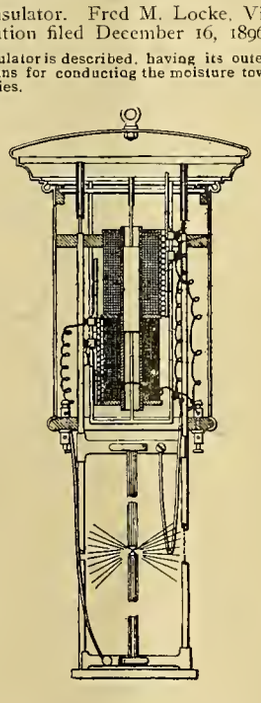
A permanent magnet has a stationary body portion, with a metallic disk rotating in the field thereof, the magnet having polar projections adjustable in a direction vertical to the plane of the disk.

590,786. Incandescent Lamp. James Bradley, Boston, Mass. Application filed October 15, 1896.

Filament supports and tips therefor between the ends of the supports and the filament, and consisting of an alloy of platinum and a baser metal.

590,806. Insulator. Fred M. Locke, Victor, N. Y. Application filed December 16, 1896.

An insulator is described, having its outer skirt oblong, and means for conducting the moisture toward its lateral extremities.



NO. 590,725.

590,808. Magnetic Ore Separator. Lewis G. Rowand, Camden, N. J. Application filed December 22, 1896.

A conveyer belt travels within and beyond the magnetic field of the electric machine; a receptacle is beneath the conveyer within vertical lines through the horizontal limits of the magnetic field, and another receptacle is beneath the conveyer beyond the magnetic field of the electric machine.

590,809. Magnetic Ore Separator. Lewis G. Rowand, Camden, N. J. Application filed January 22, 1897.

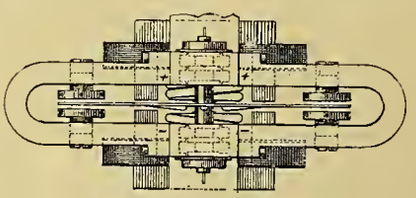
Conveyer belts extend within and beyond the magnetic field of the electric machine, there being a space beneath the conveyers within vertical lines through the horizontal limits of the magnetic field, and a receptacle beneath each conveyer beyond the magnetic field.

590,813. Controller Circuit Breaker. Thorsten von Zweigbergk, Cleveland, O. Application filed March 15, 1897.

A magnet core has continuously wound field coils surrounding it and two pole-pieces projecting from it, armature coils surround the two pole-pieces in opposite directions, and an armature is oscillatably journaled in suitable relation to the pole-pieces.

590,832. Insulator. Fred B. Grimm and John H. Nessler, Quincy, Ill. Application filed January 4, 1897.

This insulator is provided in its top with a transverse sigmoidal wire-receiving groove having downwardly convergent side walls formed with a plurality of upright channels.



NO. 590,777.

590,838. Incandescent Electric Lamp Fixture. Benjamin B. Hoffman, New York, N. Y. Application filed February 6, 1897.

The electric lamp fixture has a hollow base, a battery within the base, a cover for the base upon which is mounted the lamp supporting stem or arm which forms one side of the lamp circuit, two insulated metal rods within the stem, one for making contact with one of the lamp terminals and the other for making contact with one of the battery terminals, and a circuit controller for making contact between the rods.

590,852. Electrical Transformer. William D. Packard and James W. Packard, Warren, O. Application filed May 5, 1897.

Core plates composed of strips of magnetic metal are bent to form corners between the portions.

590,881. Electric Railway. John W. Darley, Jr., Baltimore, Md. Application filed January 13, 1896. Patented in France January 9, 1896, and in England January 17, 1896.

This electric railroad is provided with a sectional conductor and armatures operating as switches along the roadway for cutting the conductor sections into and out of circuit, two traveling electro-magnets, one closing and the other opening the switches, and means for shifting the magnets laterally.

590,882. Electric Railway. John W. Darley, Jr., Baltimore, Md. Application filed August 1, 1896.

A magnet frame provided with grooved tracks at each end is mounted independently of the truck; magnets are suspended from rollers traveling in the grooved tracks with means for moving the magnets laterally, and means operated by the magnets for completing the electric circuit through the motor on the car.

590,910. Rheostat. Thomas M. Pusey, Kennett Square, Pa. Application filed February 3, 1897.

A rheostat comprising a base, a series of contact plates arranged thereon, a threaded rod extended from the center of the base, an interiorly threaded sleeve engaging the rod, a contact arm mounted to rotate on the sleeve, the contact arm consisting of two sections removably clamped together, a peripherally grooved wheel mounted to rotate on a sleeve extended from the hub of the contact arm, the sleeve surrounding the first-named sleeve, a setting arm attached to the sleeve extended from the hub of the contact arm at the outer side of the grooved wheel, a spring-plate attached to the setting arm, a dog attached to the spring plate and extended through an opening in the arm to engage in any one of a series of notches formed in the outer surface of the grooved wheel, and a rocking finger on the setting arm engaged by the forwardly extended portion of the spring-plate.

590,916. Electric Heater. Richard A. L. Snyder, Pittsburg, Pa., and August F. Tinnerholm, Detroit, Mich. Application filed December 22, 1896.

This apparatus is composed of a metallic part to be heated, a metallic core, layers of resistance wire arranged on the core and insulated therefrom, a metallic strip between the layers of resistance wire and insulated therefrom, the strip in metallic contact with the part to be heated.

Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, OCTOBER 16, 1897. No. 16

Electrical Illumination of the Whirlpool Rapids.

The building of the Great Gorge route at Niagara Falls afforded visitors to that famous resort another feature of interest and placed at the command of lovers of scenery an opportunity for studying one of the most attractive and impressive works of nature, the Whirlpool Rapids.

That road extends along the American bank of the Niagara River from the observation tower in the center of the city of Niagara Falls to Lewiston, passing the Whirlpool Rapids and many other points of interest. It affords a splendid view of the falls in the distance and the features of interest along the Canadian bank as well as on the American side, but all other attractions pale into insignificance in comparison with the wonders of the whirlpool. This point, which has long been celebrated in song and story, takes on new interest since opportunity has been afforded visitors to make a close inspection of its beauties from the Great Gorge road. It has indeed proved the greatest attraction in and about Niagara Falls during the season just closing, and this fact has led to the further development of the possibilities of this great natural phenomenon.

It has long been the dream of enthusiasts to view the river, the falls and the rapids at night, illuminated by powerful electric searchlights or other means, but heretofore this has been deemed impracticable owing to the inaccessibility of many of the most important points of interest. The Great Gorge route, however, passes so close to the Whirlpool Rapids that the spray is felt by passengers on the open cars that are operated on this line, and it has therefore been deemed practicable to illuminate this point at least. Plans have been perfected for making this the central feature of entertainment at the convention of the American Street Railway association at Niagara Falls next week.

The first effort of the kind was successfully accomplished during the convention of the Edison association last month, when the possibilities of the searchlight in creating startling effects upon a rushing torrent of water were clearly demonstrated. The idea originated with Luther Stieringer, whose experience with searchlight effects on moving waters, gained from the electric fountains at the World's Fair at Chicago, enabled him to gauge the probable success of the experiment. A flat car was provided and upon this was placed the searchlights and screens used. On the occasion alluded to the illumination was merely in the nature of a trial demonstration of the feasibility of Mr. Stieringer's idea, which comprehends ultimately the illumination of the Whirlpool Rapids nightly during the season on a very much larger and more substantial scale. Six standard General Electric searchlights were set in six plain wooden boxes painted dead black inside. In front of each arc lamp, attached to the back of the box, was a polished silvered reflector. The boxes were placed on the flat car and the lights were controlled by a rheostat, also on the car. Apparatus of similar design and construction will continue to be used, although it may be somewhat modified.

According to the programme prepared for the convention next week, it is proposed on Tuesday evening to take the delegates and visitors on special cars down the gorge opposite the point in the Whirlpool Rapids where the movement is most turbulent, when the lights on the cars will be suddenly extinguished and the illumination by means of the searchlights begun. It will be necessary to arrange for an early start in order that the illumination may be made before the moon has risen, as much more startling effects can be produced when the gorge has the appearance of a cave, while the water tossing and leaping and madly rushing along lends wild enchantment to the scene. But when the current is turned on the searchlights the effect is intensified by the beam of white light that penetrates the darkness of the night and illuminates the river-bed and opposite shore. This view of the masses of tumbling, roaring waters is more than magical. They seem to be endowed with a new life, weaving and interweaving in white, fleecy foam and pale emerald overturn, curving under and over as they dash onward. It is certainly a new view of the rapids, and it conveys perhaps a better idea of the force and violence of the current than can be gained by an inspection during the day. The surroundings naturally lend much to the impressiveness of the of the scene.

It has been demonstrated that the effect can be greatly heightened by the use of colored screens. When, for instance, a red screen is used the effect produced shows that the climax is not reached with the pure white light, as the water takes on an almost blood-red hue, such as is found in the depths of a furnace of molten metal, the undercurrent moves onward in deep red, while the leaping foam has a lighter hue. This combination of colors can be added to at the will of the operator. In view of the possibilities here presented, it is not too much to expect that this will prove the most popular feature of the many attractions in and about Niagara Falls.

ELECTRICAL ILLUMINATION OF THE WHIRLPOOL RAPIDS.

Glasgow International Show.

Glasgow, the second city in Great Britain, having decided to hold an International Exhibition in 1901, the citizens have already started preliminary operations, and, according to a cable dispatch, they avow their intention of beating Chicago's record. The guarantee fund amounts to $750,000. It is expected that the total, $5,000,000, will be raised within six months.

American Street Railway Association.

The last detail in the arrangements for the sixteenth annual meeting of the American Street Railway association at Niagara Falls, N. Y., October 19th-22d, has been settled, the final revision of the programme has been made and the allotment of space in the exhibition hall has been concluded. The official diagram, showing the location of exhibitors, is presented herewith. Secretary Penington, in making this final revision, announced that no further changes would be made. It requires only a glance to confirm the impression that the exhibition this year, as well as the meeting itself, will partake largely of the character of an electrical event.

The official programme of the meeting was published in this journal on October 2d, and it is only necessary to recall some of the more important features at this time. Papers upon the subjects mentioned are to be read by the following-named gentlemen:

"Municipal Ownership of Street Railways," P. F. Sullivan.

"Some Difficulties Existing in the Construction and Operation of Electric Street Railways," G. W. Knox.

"Application of Storage Battery to Electric Traction," Charles Hewitt.

"Power Distribution and Use of Multiphase Current Transmission for Ordinary Street Railways," Maurice Hoopes.

"Discipline of Employes," George H. Davis.

"Application of Electricity to Railroads Now Operated by Steam Power," H. N. Heft.

"Best Method of Settling Damage Cases and Prevention of Accidents by Use of Fenders and Otherwise," Willard J. Held.

There will be a number of excellent speeches made during the convention, including the annual address of the president and the address of welcome by Mayor Hastings of Niagara Falls.

The social event of the gathering will be the annual dinner at the International Hotel on Thursday evening. The illumination of the Whirlpool Rapids is announced for Tuesday evening.

On Tuesday afternoon delegates and visitors will inspect the power house of the Niagara Falls Hydraulic Power and Manufacturing company, the power house of the Niagara Falls Power company and the factories of the Niagara Falls Paper company and the Carborundum company.

Wednesday afternoon will be devoted to the examination of points of interest about Niagara Falls. The visitors will walk across the upper suspension bridge to the Canadian side, where the cars of the Niagara Falls Park and River Railroad company will convey the party to Chippawa and Queenston, where the steam ferry of the Niagara Falls Navigation company will be taken to Lewiston, from which point they will return by the Great Gorge Route to Niagara Falls.

The ladies of the party will be taken to Youngstown and Fort Niagara over the Great Gorge Route and the Frontier railroad, in charge of the ladies' reception committee assisted by gentlemen of the reception committee, on Thursday morning.

AMERICAN STREET RAILWAY ASSOCIATION—FLOOR PLAN AND LIST OF EXHIBITORS.

No. of space.	Exhibitors.	Square feet.
1	Street Railway Review, Chicago	100
2	Street Railway Journal, New York	100
3a	Westinghouse Electric and Manufacturing company, Pittsburg	920
3b	Barney & Smith Car company, Dayton	350
4	General Electric company, Schenectady	1,100
5	Walker company, Cleveland	700
6	Wells & French company, Chicago	350
7	Cambria Iron company, Philadelphia	100
8	John T. McRoy, Chicago	100
9	Paul Jones, Cincinnati	100
10	Adams & Westlake company, Chicago	100
11	Mica Insulating company, Chicago	100
12	Trojan Button Fastener company, Troy	100
13	C. N. Wood, Boston	100
14	Corning Brake Shoe company, Buffalo	100
15	Murphy Manufacturing company, Pittsburg	480
16	Edison-Brown Plastic Rail Bond company, New York	150
17	Consolidated Car Fender company, Providence	200
18	Christensen Engineering company, Milwaukee	900
19	Cutter Electric and Manufacturing company, Philadelphia	100
20	American Railway Supply company, New York	100
21	Fuel Economizer company, Matteawan	100
22	Central Electric company, Chicago	300
23	E. T. Burrows & Co., Portland	175
25	Pomeroy & Fischer, New York	100
26	Cleveland Frog and Crossing company, Cleveland	150
27	D. J. Sinclair, New York	100
28	J. G. Brill company, Philadelphia	650
29	Standard Air Brake company, New York	250
30	William Wharton, Jr., & Co., Philadelphia	250
31	Ohio Brass company, Mansfield, O	200
32	Creaghead Engineering company, Cincinnati	200
33	Falk Manufacturing company, Milwaukee	200
34	R. D. Nuttall company, Allegheny, Pa	200
35	Clarence Whitman & Co., New York	150
36	W. F. Ellis, Boston	100
37	Electric Mutual Casualty Association, Philadelphia	100
38	Detroit Stove Works, Detroit	100
39	H. W. Johns Manufacturing company, New York	200
40	Pennsylvania Steel company, Steelton, Pa.	350
41	McGuire Manufacturing company, Chicago	600
42	Peckham Motor Truck and Wheel company, New York	800
43	Taylor Electric Truck company, Troy	340
44	Forsythe Bros. & Co., Chicago	100
45	Rochester Car Wheel Works, Rochester	200
46	New York Car Wheel Works, Buffalo	300
47	New Haven Car Register company, New Haven, Conn.	100
48	A. O. Norton, Boston	100
49	Meaker Manufacturing company, North Chicago	200
50	International Register company, Chicago	100
51	Springfield Manufacturing company, Bridgeport, Conn.	100
52	St. Louis Register company, St. Louis	200
53	Johnson company, Lorain, O., and Johnstown, Pa.	950
54	Sargent company, Chicago	100
55	Edward P. Sharp, Buffalo	100
56	W. T. Van Dorn & Co., Chicago	100
57	Gold Street Car Heater company, New York	150
58	F. H. Newcomb, Brooklyn	100
59	Cleveland Construction company, Akron, Ohio	100
60	Charles Scott Spring company, Philadelphia	100
61	Monarch Stove company, Mansfield, Ohio.	100
62	Diamond Truck company, Kingston, N. Y.	500
62½	Joyce-Gridlaw company, Dayton, Ohio	100
63	Consolidated Car Heating company, Albany	150
64	Crane company, Chicago	200
65	Standard Underground Cable company, Pittsburg	100
66	Electric Storage Battery company, Philadelphia	100
67	National Water Tube company, New Brunswick, N. J.	100
68	Pettingell, Andrews & Co., Boston	Wall

Ten Years Ago.

It is interesting at this time to recall the convention at Philadelphia 10 years ago, when electricity first created a stir in street railway circles. The character of that gathering may be judged from the design that appeared on the menu of the annual dinner. It was, strictly speaking, a horse railway organization, and it was not changed into an electrical association without vigorous and spirited protests from members who had no sympathy for the new order of things. However, the printed proceedings of the Philadelphia meeting show that considerable time was devoted to the discussion of a paper on electric traction, which was read by William Wharton, Jr., of Philadelphia. Among those who participated in this discussion were Frank J. Sprague and Charles J. Van Depoele. Calvin S. Richards, president of the Metropolitan Railroad company of Boston, was an enthusiastic advocate of the trolley, and Charles B. Thurston, president of the Jersey City and Bergen Railroad company, was one of the most persistent seekers after information. The latter gentleman asked Mr. Sprague, among other questions, whether it would be advisable to have horses pull cars up a grade of six per cent., provided the electric system was introduced.

There are many other interesting features in the report of the Philadelphia meeting, not the least of which is the announcement that Charles B. Holmes of Chicago, who was elected president, was notified by telegraph, and that he sent his acceptance by "duplicate message" over the Western Union and

AMERICAN STREET RAILWAY ASSOCIATION—TEN YEARS AGO.

Baltimore and Ohio telegraph lines, "in order to insure its reception."

An idea of the character of street railway literature of 10 years ago may be gained from the title of one of the papers printed in the official proceedings of the Philadelphia meeting, "Does the Use of Salt on Snow Act Prejudicially Upon Horses' Feet?" which was at that time a subject of absorbing interest.

Street-car Fares in Cleveland.

Agitation of the question of lower street-car fares in Cleveland has brought from the companies the offer to adopt a rate of six tickets for 25 cents, universal transfers, and a reasonable percentage of the gross receipts to be paid into the city treasury. The companies ask in return an extension of all franchises for 25 years from this date and a release from all obligations to keep the street between their tracks in repair. It is said that the authorities will compromise on an extension of all grants to the

year 1914—the time limit of the longest existing franchise—if the companies will agree to pay five per cent. of their annual gross receipts into the city treasury. Other features of the proposition are pleasing to both parties. The prospective agreement is the outcome of an agitation for lower fares begun with the introduction in the City Council of an ordinance providing for the sale of eight tickets for 25 cents during the busy hours of the day. The legal department suggested that the restriction as to hours would not do, and proposed that the ordinance be made to read eight tickets for 25 cents at all hours. This alarmed the companies, and their proposition was the result.

Trolley Freight Service at Niagara.

By Orrin E. Dunlap.

That the handling of freight is getting to be an important department on some trolley lines is made clear by the showing in this line of business on the electric road that runs between the villages of Youngstown and Lewiston, in Niagara county. This line runs through one of the best fruit-growing localities in New York state, and until the trolley line pierced the farming section the farmers were forced to draw fruit intended for shipment several miles to Lewiston, where the tracks of the New York Central are reached. Now matters relating to shipment are simplified by running regular steam road freight cars down the electric road to desired points, where they are loaded with fruit and returned to Lewiston for shipment over the New York Central. This year the peach crop of this section of Niagara county was enormous, and the part the trolley played in placing it on the market with promptness is worthy of record.

In order that the accommodations for hauling the cars should be of the best and not interfere with the regular traffic of the road, a motor car was provided for drawing freight trains, and it is doubtful if any trolley line can show greater freight activity than the road referred to. The motor car has an extreme length of 20 feet, the length of the box being 14 feet. The height from top of rail to top of car is 10 feet 8 inches, while the car rests on a single truck especially designed for strength with a seven-foot wheel base. The frame of the car is of heavy oak timber, and it weighs seven tons. It has a capacity of 10 tons additional. A Gould coupler and a radial draw-bar are provided in order that the car may be coupled to freight cars or to street-car trailers. Two General Electric 1200 four-turn motors are provided, and these are wound in such a way as to exert a high tractive effect for a given amount of power. These motors are about 50 horse power each, and they can pull several loaded freight cars on level grades. The car has been fitted with road scrapers and a snow plow, and during the winter it will be used for keeping the tracks free from snow. The plans and specifications for the car were prepared by Robert B. Goodman.

In Fig. 1 will be seen a view on a siding on this road in the village of Youngstown. The cars are being loaded with peaches, and as far down the road as the eye can see wagons are standing waiting their turn to unload. Other wagons are standing by, loaded with freight of troops being transferred from Fort Niagara to Fort Porter, in Buffalo.

The liveliness of the scene would do credit to a freight house of a well established steam road. In Fig. 2 the motor car described is to be seen attached to a train of freight cars bound for Lewiston, where they are turned over to the New York Central company for shipment to the markets of the country.

Englewood and Chicago Road Sold Under Foreclosure.

As the result of the foreclosure proceedings brought by Stephen D. Bayer, a stockholder, the property of the Englewood and Chicago Electric Street Railway company was sold at public auction on the courthouse steps in Chicago on October 12th. There was but one bid—that of the reorganization committee of the eastern bondholders, represented by Jules S. Bache of New York, of $260,000, and this was accepted by the master in chancery who conducted the sale. The company was chartered early in 1894, and had a capital stock of $2,500,000. Bonds to the amount of $1,000,000 were issued. The road was built for operation by storage batteries on the cars, and therefore has an especial interest to electrical men. It was described at some length in the Western Electrician of August 7th last. The actual value of the property is believed to be easily a million dollars. G. Herbert Condict, the engineer who built the road, was appointed receiver last January.

The affairs of the company are in a somewhat complicated state, owing largely to claims growing out of the disposal of the old Jacobs franchise under which the road is operated. The reorganization committee spoken of consists of Alfred S. Heidelbach, Jules S. Bache and Samuel R. Shipley of New York and Isaac L. Rice of Philadelphia. They represent the holders of $700,000 of the company's bonds. The balance of the bonds, amounting to $218,000, are owned by a large number of small holders, who do not appear to be "in it" to a very large extent. The other liabilities of the road consist of receivers' certificates, $60,000 of the first series ordered by the court January 19th, $242,000 of a second series ordered to pay for the construction of the road and other expenses, which bring the amount up to $327,000. As soon as the sale is confirmed by the court the proceeds will be used to pay the first issue of the receiver's certificates in full. Holders of the second series will receive about 71 cents on the dollar. Many of the larger holders of the certificates, material men and building contractors, have agreed to join in the plan of reorganization. By agreement they will receive half of their claims in cash and the remainder in the stock of the reorganized company. The operation of the road will be continued by Mr. Condict. Application will at once be made to Judge Showalter for a confirmation of the sale. Following his action, the purchasers of the road will probably organize a new company.

There has been some talk of the consolidation of this road with the Calumet and South Chicago systems and the securing of the General Electric franchise for a trunk line down-town. Such a system would prove a very formidable rival to the Chicago City Railway company; but the prospect that the scheme will be realized is very shadowy.

FIG. 1. TROLLEY FREIGHT SERVICE AT NIAGARA.—LOADING FREIGHT ON THE "OLD FORT ROUTE."

FIG. 2. TROLLEY FREIGHT SERVICE AT NIAGARA.—MOTOR CAR DRAWING A FREIGHT TRAIN ON THE "OLD FORT ROUTE."

Convention Train.

The Wabash Railroad company will run a special train from Chicago to Niagara Falls on Monday, October 18th, to accommodate the western delegates and visitors to the American Street Railway association. The train will leave the Dearborn station on Monday at 3 p. m.

Use of Electricity in Vienna.

The Chamber of Commerce of Vienna, in its annual report for 1896, describes the development of electric light and power transmission in that city, and quotes interesting returns from three firms. The first is the Austrian General Electric company, which has a length of cable of about 52 miles, supplying about 3,074 customers. There are 69,502 incandescent lamps, 2,811 arc lamps and 341 motors, equal to 199,264 30-watt lamps. The number of motors has increased considerably, chiefly on account of their being used for elevators in private houses. The International company has about 3,630 customers, taking about 75,000 lamps of 16 candle power, including about 1,900 arc lamps and 163 motors of 285 horse power. The central station is now increased to a capacity of 8,500 horse power, as compared with 7,200 horse power in the previous year, and the length of cable is about 116 miles. The number of customers is 2,938, using 6,932 kilowatts. The electric railway which this company fitted out is being extended from about five miles (its present length) to about seven miles. The great scheme for an electric railway which was started in 1895 has up till now only resulted in an experiment. A section of line formerly used for horse traction has been converted to electric traction, and the experiment has answered so well that the Municipal Council decided to acquire the concession for the construction of all electric lines, and is even now considering various offers for the

equipment of the lines. The third company whose returns are quoted in the Chamber of Commerce report is the Vienna Electric company, which has laid about 23 miles of cable, supplying 41,140 lamps and 275 motors, with a total output of 708 horse power. The total kilowatt capacity of the three stations for the year was 15,887, against 12,385 for the previous year, an increase of 3,502 kilowatts. There is a very rapid increase noted in the use of electric motors. Since May, 1896, the three companies had had in use a tariff for single-phase current which was cheaper and simpler than the former tariffs. For one kilowatt-hour the charge is 16 cents up to 60 hours, and above that figure the cost is fixed at 10 cents per hour. For industrial uses the charge is from 10 to five cents.

Electricity at the Trans-Mississippi Exposition.

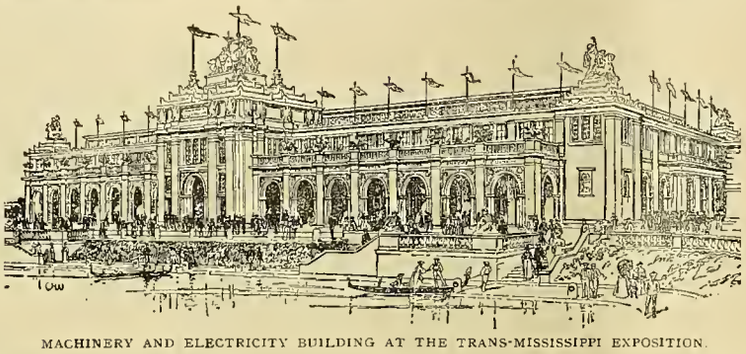
Luther Stieringer, the well-known authority on decorative and interior lighting, has been engaged as consulting electrical engineer of the Trans-Mississippi and International Exposition to be held in Omaha next summer. Mr. Stieringer has had a wide experience. He was one of the men associated with Edison in the pioneer days of incandescent lighting, and he designed some of the first electric lighting fixtures to be commercially employed He was prominently connected with the famous Edison exhibit at the Paris Exposition of 1889, and he has had something to do with the electrical part of almost every American exhibition where electricity was largely employed. At the World's Fair his services were sought at an early stage of the construction work and his advice was in constant demand. Among other features he designed the twin electric fountains and suggested the great arc light coronas in the Manufactures building. Only last month he arranged the very striking illumination of the Whirlpool Rapids near Niagara Falls, which forms the subject of illustration in the frontispiece of this issue of the Western Electrician. Mr. Stieringer contemplates further experiments along this line in the night illuminations at the Trans-Mississippi Exposition, principal among which will be an electric garden, showing the various hues and tints of the flowers by means of colored screens and powerful searchlights. There will also be demonstrations with searchlight effects on the moving waters of the Missouri River for a long distance, and also on the bluffs on both sides.

Probably the American Institute of Electrical Engineers and the National Electric Light association will hold their meetings in Omaha during the exposition season, and these gatherings will be a strong incentive for a complete demonstration of all the applications of electricity. Special features will embrace electricity in agricultural work, long-distance power transmission, recent applications of electricity in power distribution, electricity in mining, electro-metallurgical processes, long-distance telephony, domestic applications of electricity for cooking, ironing and heating purposes, and the transmission of intelligence by Hertzian waves.

Professor R. B. Owens of the University of Nebraska, commissioner for the electrical section of the exposition, has secured the following-named exhibits: Direct current, single and multiphase motors for stationary use, railway apparatus, electric mining apparatus, high-frequency and high-potential apparatus, telephone and telegraph apparatus, electric wire-making machinery, electro-chemical processes for the reduction of metals, searchlights, electric supplies and specialties.

Application has been made and space assigned to the following-named electrical concerns: The Walker company, Fort Wayne corporation, General Electric company, Western Electric company, Wagner Electric and Manufacturing company, Crocker-Wheeler Electric company, Okonite company, Cutter Electric and Manufacturing company, Keystone Electrical Instrument company, Cutler-Hammer company, Elmer G. Willyoung company.

Most of these exhibits will be housed in the Machinery and Electricity building, which is herewith illustrated. This building is located in the northeast corner of the grand court, being east of the Mines building and across the lagoon from the Manufactures building. It has a frontage of 304 feet and is 144 feet deep. There are triple entrances on the main floor level in the center of the main front and similar groups in the centers of the east and west fronts, with four emergency exits in the north wall. In front of the building, flanking both sides of the main entrance, is an open portico 16 feet wide, running the entire front of the building. The center entrance feature projects beyond the portico, thus forming the grand entrance vestibule. Above the main floor is a gallery 32 feet in width, extending around the four outer walls. The gallery is reached by spacious staircases located in the front corners of the building. In the rear corners are commodious toilet rooms. This leaves a high central court 248 feet long by 80 feet wide, lighted from the skylights and clere-story windows above the roof.



MACHINERY AND ELECTRICITY BUILDING AT THE TRANS-MISSISSIPPI EXPOSITION.

The character of the exhibits sheltered by this building is shown by the decoration. The ornamental spandrels and panels receive all of their motifs and suggestions from machinery. The cresting at the top is composed of cogwheels, this principle being carried out in all of the decorations. The underlying principle and function of machinery is symbolized by the groups of statuary on the top of the building. At each of the four corners are groups representing the early supremacy of man over the untamed forces of nature. These forces are represented by wild animals. Men in their youth are seen subduing them for the simple purpose of escaping injury and the preservation of their own lives at the sacrifice of the natural forces. A higher supremacy is shown by the center group, which is the dominating feature of the entire design. In this, man, developed beyond the youthful stage, having wisdom, takes these same untamed, unharnessed forces of nature and harnesses them to his chariot, making them do his bidding, symbolizing in a direct way the service which machinery does for man in using the powers of steam, electricity and gravity.

Color enters into the design with maximum importance. The ornaments in the panels under the porticos and over the main entrances will be highly emphasized by small background spaces of strong colors. The entire building will be a series of yellow and ivory tones, growing more intense as they reach the top, culminating in the dull golden statuary which surmounts the building and symbolizes its use. The building was designed by Dwight H. Perkins of Chicago.

First Street Railway at Niagara Falls.

It is an interesting coincidence that the American Street Railway association should select Niagara Falls as the place for holding its meeting on the fifteenth anniversary of the date when the first steps were taken to build a street railway in the territory now known as the city of Niagara Falls.

October 20, 1882, was the date of the charter of the Niagara Falls and Suspension Bridge Street Railway company, and a day later the articles of incorporation were filed in the office of the secretary of state in Albany. The chief promoter of the first street railway in what was then the two villages of Niagara Falls and Suspension Bridge was Arthur Schoellkopf, and the company he aided in organizing built a road about 1⅞ miles long, extending from the foot of Falls street, Niagara Falls, to North avenue, Suspension Bridge, on Second street, Ontario avenue and along what was then Lewiston avenue, near Main street, in the former village of Suspension Bridge. Horse cars were used, and the picture in connection with this article well portrays the service of that time. This original horse-car line was most successfully managed by the company, despite all the predictions that "it would not pay." It proved to be quite a mint in its way, and thousands of excursionists found it a ready and rapid means of going from the falls to the rapids. In 1890 Orrin E. Dunlap secured an option on the

E. H. ABADIE.

road, which resulted in its sale to the present company. The line was then a single track. Soon after the new life was infused into the company electricity was adopted and the road extended. In the summer of 1892 the road was rebuilt and double tracked. Extensions on Falls, Erie and Buffalo streets to Sugar street were constructed in 1891, while in 1892 extensions on Whirlpool avenue, Chasm avenue, Ontario avenue, Sugar street and Pine avenue were built. The capital stock of the original company was $50,000. This was increased in 1891 to $100,000, and again in 1892 to $250,000. In 1893 it was further increased to $750,000, and the number of shares reduced from 30,000 at $25 per share to 7,500 at $100 per share.

FIRST STREET RAILWAY AT NIAGARA FALLS.—OLD HORSE-CAR SERVICE.

The total length of line owned by this company is 13.26 miles. The road is double tracked on Falls, Second and Main streets, also on Erie and Buffalo avenues to Sugar street. The Ontario avenue line is a single track, as are also the Whirlpool avenue, Pine avenue and Sugar street lines. The company also operates the Whirlpool and Northern line, which is a single track, running to the Devil's Hole. The equipment of the road is first-class throughout. When electricity was first adopted as the motive power, a plant was installed in the car barns on Main street, but the power supply is now taken from the Niagara Falls Power company. The rate of fare is five cents, half-fare tickets being sold for use during certain hours in the evening and morning. The president of the company is Captain J. T. Jones of Buffalo, the superintendent being J. C. Brewster.

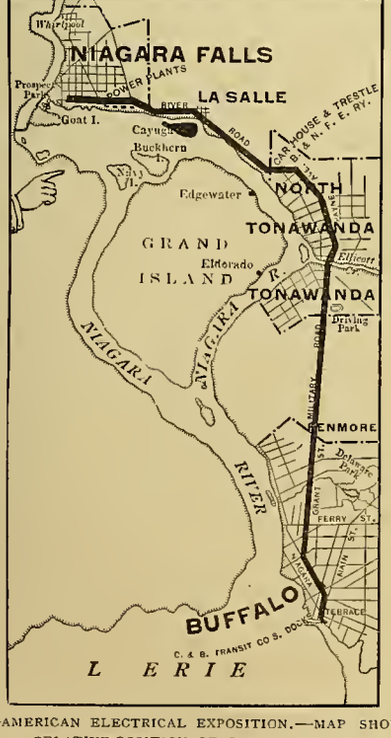
Besides this local line, the Buffalo and Niagara Falls electric road and the Niagara Falls and Lewiston road both run to the falls, and afford the best of facilities, thus making clear that few cities of the size of Niagara Falls can boast of such exceptional street railway service, both in the city and to adjoining towns.

E. H. Abadie.

"With the Wagner company since '91," was the answer of the subject of this sketch to a question recently put by a friend as to the period of his identification with this company. The fact that Mr. Abadie, through all the changes and upheavals of the electrical business during this extended period, has retained the confidence of the company and continued in the position of manager of sales, together with the additional fact that even through the stringent times just drawing to a close the Wagner company's business has prospered, indicate that the sales department has been ably conducted. Well known as Mr. Abadie is through his extensive correspondence with the various buyers of electrical apparatus throughout the United States and abroad, it is safe to say that many of them have never seen his face, and the accompanying portrait will therefore be of interest. A young man, energetic, progressive and of most pleasing address, backed, too, by a thorough knowledge of a business full of technicalities, Mr. Abadie is eminently fitted for his responsible position; and those who know him intimately do not wonder at his pronounced success. For years Mr. Abadie has been a constant attendant at almost every gathering of electrical men, and during last year's convention of street car men in St. Louis he added to his laurels through his unfailing courtesy and hospitality to the visitors in his home city. Mr. Abadie is a member of the Mercantile Club of St. Louis, also of the University Club in the same city, and his friends are numbered among the best business men in his section.

Pan-American Electrical Exposition.

Cayuga Island, the site selected for the Pan-American Electrical Exposition in 1899, is located in the Niagara River opposite La Salle, which is practically a suburb of Niagara Falls, and so it may be understood that the exposition will be at Niagara Falls. In its area the island has 175 acres, which is ample room for the exposition, but should more land be required it can easily be acquired on the mainland. The views and map presented herewith



PAN-AMERICAN ELECTRICAL EXPOSITION.—MAP SHOWING RELATIVE POSITION OF CAYUGA ISLAND.

picture with accuracy the location of the island and the beauty of its surroundings.

The company that is to control the great show includes Dr. Chauncey M. Depew, president of the New York Central and Hudson River Railroad company; E. B. Thomas, president of the Erie Railroad company; the Hon. Roswell P. Flower, ex-governor of New York; H. Walter Webb, vice-president, and Edgar Van Etten, general superintendent of the New York Central; Daniel O'Day, general manager and vice-president of the United Pipe Lines company; Hon. W. F. Sheehan, ex-lieutenant-governor of New York; John M. Brinker, president of the Niagara Falls and Lewiston Electric Railroad company; F. C. M. Lautz, vice-president of the same company and president of the Ellicott Square Bank of Buffalo; Capt. J. T. Jones, president of the Niagara Falls and Suspension Bridge Street Railway company, the largest individual oil producer in the United States; Charles R. Huntley, general manager of the Buffalo General Electric company; Charles R. Haskins, formerly manager of the Wisconsin Telephone company of Milwaukee, Wis.; Hon. W. Caryl Ely, president of the Buffalo and Niagara Falls Electric Railway company; Henry J. Pierce, president of the Manhattan Spirit company; Howard H. Baker, postmaster of Buffalo; Hobart Weed, F. S. McGraw, Herbert P. Bissell and R. C. Hill of Buffalo. The directors for the first year are: Hon. Roswell P. Flower, Hon. Chauncey M. Depew, H. Walter Webb, Daniel O'Day, Edgar Van Etten, William F. Sheehan, John M. Brinker, F. C. M. Lautz, Charles R. Haskins, Charles R. Huntley, E. B. Thomas, Hon. W. Caryl Ely and Herbert P. Bissell. The directors

View toward the Mouth of the Little Niagara.

Head of Cayuga Island and Entrance to Little Niagara River.

Looking up the Little Niagara toward La Salle.

Outside View of Cayuga Island, with Spray Cloud of the Falls in the Distance.

PAN-AMERICAN ELECTRICAL EXPOSITION.

have elected these officers: President, John M. Brinker; first vice-president, the Hon. Roswell P. Flower; second vice-president, the Hon. Chauncey M. Depew; third vice-president, E. B. Thomas; treasurer, F. C. M. Lautz; secretary, R. C. Hill.

One significant thing about the company is the vast railroad interests represented on its board of directors. Cayuga Island was selected as the site for the exposition because of the excellent transportation facilities it affords. Within 200 feet of the island run the New York Central and Erie tracks, over which speed the trains of the New York Central, Erie, West Shore, Grand Trunk, Michigan Central, Lehigh Valley, Rome, Watertown and Ogdensburg, Canadian Pacific, Lake Shore and Wabash lines. The island has a magnificent river frontage where boats can land, thus making it possible to run excursions both by rail and water to the exposition. There is ample woodland on the island to make delightful groves where visitors may rest and enjoy the cool breezes of the ever-beautiful Niagara.

The small village on the mainland opposite the island is named after La Salle, the famous French explorer, who on December 6, 1678, brought his brigantine of less than a dozen tons to anchor near the mouth of the Niagara, and traveled through the forest to the little stream now known as Cayuga Creek, where some historians say he built the Griffon, the first vessel other than Indian canoes to sail the great lakes. The work of preparing for the exposition will naturally throw new life into this village, as no time is to be lost in erecting the buildings.

Details of the plans for the exposition are now under consideration. At a recent meeting of the board of directors in New York the general plans were submitted and approved. The first stake for the exposition was driven by President McKinley when he visited Buffalo recently to attend the Grand Army encampment. When the Pan-American delegates in June last visited Cayuga Island they inspected and approved the site. The officials of the exposition company say that applications for space have been far ahead of anything expected. The applicants include many of the persons who are going to exhibit at the Paris exposition in 1900. They intend showing their exhibits at Cayuga first and moving them across the Atlantic when the Pan-American exposition closes.

The exposition is intended to be representative of the progress made in the Pan-American countries during the century which will be closing in 1899. It will be kept open from May until November, and all the machinery on the island will be operated by electricity generated in the big power house at Niagara Falls. The heating and cooking will be done by electricity, if possible, and boilers and smokestacks will be excluded from the island. The cars of the Buffalo and Niagara Falls electric railway pass between the tracks of the steam railroads and the island, thus assuring trolley as well as steam railway and boat facilities.

The Little Niagara River and Cayuga Creek are recognized as ideal for the operation of electric launches, which will be an important feature of the exposition.

The reports of the commissioners of the State Reservation at Niagara Falls establish the fact that 500,000 people visit the falls annually to see the great cataract, and it is confidently expected that with the added attractions of the exposition and the remarkably low rates that the railroads will offer the number of visitors to the falls in 1899 will be more than doubled, if not trebled. This means a constant crowd during the period of the exposition, and the attendance, it is confidently anticipated, will compare very favorably with any exposition or fair ever held in the world.

American Development and English Comment.

Considerable fuss has been made with regard to the electrical equipment contract for this line [Central London railway] going to the United States. As a matter of fact, however, we believe that no small part of the plant will be made in Berlin at the works of the Union Elektricitäts Gesellschaft; but although manufactured under a name of such repute, it may be doubted whether the patriots who wanted all the equipment to be turned out in this country would not just as soon have bought it in the United States as Germany, if buying were necessary.—Electrical Review, London.

It is pretty well understood that our American competitors have exploited almost every corner of the world in order to introduce electric traction. We commend their business energy, but certainly we can wish that the electrical firms in England had followed a similar course. At the present moment we believe Mr. Gustave Fischer, the engineer for tramway traction in New South Wales, is in America to supervise the construction of the electric apparatus for tramway work which is being made at Milwaukee. We can only trust that in the end the fable of the hare and the tortoise may be followed, and that in the long run the race for traction work will show that English manufacturers at any rate are not behindhand with any other competitors.—Electrical Engineer, London.

The total mileage of electric traction in Europe comes to 940 miles, on which are employed about 300 carriages. In America the total mileage is about 12,500 miles [15,000 would be a more accurate figure], but the circumstances are of course different. Progress in America and progress in Europe are two very different things, but there are many indications that Europe is going ahead now very fast, not only in the matter of electric traction, but also as regards lighting and the more general use of electricity. We know what rapid developments are taking place in England, and a perusal of the French and other Continental electric papers reveals the fact that those countries are, if anything, ahead of us in the way they are adopting electricity in small towns as well as large, especially for traction purposes.—Electrical Engineer, London.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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Thomas Jansen, being duly sworn, deposes and says that he is a resident of the city of Chicago, in the county of Cook and state of Illinois, and that he is the foreman of the printing department of the Electrician Publishing company, the publishers of the Western Electrician; that he was present at and superintended the printing of No. 24 of Vol. 20 of the Western Electrician, issued on June 12, 1897, and that there were printed by actual count 20,000 complete copies of said Western Electrician of the volume and number above specified. And further this affiant sayeth not.

THOMAS JANSEN.

Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

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Apparently the practice of holding the city of Glasgow up as a model in the way of municipal government is having its effect. Those who are opposed to the idea of cities owning and operating quasi-public enterprises claim to have investigated the subject carefully, with the result of establishing the fact that the conditions in American cities are entirely different from those that obtain at Glasgow, and that the service, which is the pride of the Scotch metropolis, would not be acceptable in much smaller communities here. The English, too, especially the people of London, resent the constant effort to magnify Glasgow's municipal greatness. This is disclosed in a recent editorial paragraph in the London Electrical Review, which says: "One has been often told by Scotch papers that the municipal government of Glasgow is the best in the world, and, no doubt, much has been done to ameliorate the condition of those who are compelled to live in Glasgow." The same journal shows by comparison that Glasgow is not by any means a fair example of British progress in the matter of the application of electricity to the needs of the people. Manchester and Leeds seem to have accomplished much more than Glasgow in this respect.

By a unanimous vote the City Council of Chicago passed an order October 13th authorizing the appointment of a committee to investigate the street railway properties of the city. The points upon which information is wanted have already been enumerated in these columns. They include original cost of property, additional investments, present valuations, dividend-yielding capacity and character of present holdings; also, information concerning the construction, maintenance, operation and management of the several systems.

The measure was advocated by Alderman Harlan on the ground that the council should be in possession of this information to act intelligently upon the proposition, when submitted by the companies, to extend the street railway franchises 50 years, under the provisions of the Allen law. When the resolution was first introduced it was referred to a committee, as some of the aldermen thought that the order was premature, contending that there was plenty of time to get this information when the street-car companies come to the council to ask the 50-year extensions of their franchises. On the other hand, it was urged that the longer the aldermen had this information before the companies could apply for extensions the better the questions could be considered when the time comes. The advocates of the measure pleaded that if they had this information they would be able to dispose of the questions when they came up, to the benefit of the public, even though the companies may not go to the council for three or five years.

Measures providing for the protection of motormen and gripmen have been introduced in the Chicago City Council. One of these provides that every person or corporation owning or operating street railways in the city of Chicago now or hereafter shall equip all motor or grip cars at the front end of each car with an inclosure during November, December, January, February and March of each year. The penalty subjects the company to a fine of not more than $50 nor less than $5 for each day and for each car used in violation of the ordinance. Another ordinance of the same nature has been introduced which also provides for heating the platforms.

The street railway companies of New Jersey will probably evade the vestibule law passed by the last Legislature, although public sentiment favors the enactment of some measure of this kind, intended to protect the motormen from the inclemency of the weather. In an opinion submitted to the police commissioners of Newark, City Counsel Price pronounces the act mentioned to be fatally defective. The first section makes it imperative for the trolley companies to use vestibuled cars; the second section seems to forbid this under penalty, thorugh a careless use of language in the drawing of the law. The second section reads as follows: "For each day or part of a day any such car, motor, or other vehicle for the conveyance of passengers, shall be operated and used in the operation of any street railroad or railway operated by means of electric motors, the company owning or operating said car, motor, or vehicle shall be liable to a penalty of $25." In his official capacity, Col. Price has given this opinion: "The words 'any such car, motor, or other vehicle,' etc., refer to the cars having a vestibule, and consequently make it a penal offense for the company to operate a car with a vestibule between the first day of November and the first day of April. You will thus perceive this is a fatal mistake in the drafting of the act."

Clearly the object of the law was to afford relief to the motorman, but the purpose of the act was defeated through faulty wording of that portion providing penalty for failure to comply with its provisions. This is not the first time that measures aimed at corporations have been defeated by some hocus pocus in the New Jersey Legisature.

Labor organizations have viewed with displeasure the utilization of the street railway systems in the principal cities of the country for the transportation of mail, but little organized opposition has been shown. It is contended that the companies in case of a strike would seek the protection of the government in case of any interference with the operation of the cars. Just how the labor organizations could consistently object and at the same time protest against violent measures is a problem that has yet to be solved. In any event the labor leaders are bent upon making trouble for the Chicago street railway companies and they have appealed to the City Council for assistance. When the employes of the Chicago City Railway company were discussing a proposition to precipitate a general strike recently, the council demanded a legal opinion on the subject, as it was then evident that much would depend upon the rights of the railway company to carry United States mails on its trains and the subsequent right to demand federal protection of the property in case of trouble. According to an opinion just submitted by Corporation Counsel Thornton, the street railway companies of Chicago are hauling United States mail and freight without authority of the city of Chicago. In the opinion it is stated that the companies are doing something which their charters from the City Council give them no right or authority to do. The city's legal department has examined the several ordinances passed by the council and acts of the Legislature granting the street railway companies the power to operate their lines, but in no case has any authority been discovered for the carrying of mail. The opinion says that undoubtedly the cable and electric lines in the city of Chicago are transporting the United States mails and carrying postal cars for the distribution of the same by order of the postmaster-general, who is authorized by statute to establish mail routes on all railroads or parts of railroads, steamboats and public highways. But it is further held that this is not sufficient. The opinion concludes with the following statement:

I fail to find anywhere any revocation of the requirement that the street car companies shall carry only passengers. No permission ever seems to have been granted by the Common Council permitting the street car companies or any of them to carry mail. The prohibition against carrying anything but passengers is in full force, and it is my opinion therefore that the street railway companies at present are carrying United States mail and running cars for the accommodation of the mails over their several routes not only without any authority whatever, but in direct opposition to the provisions of the original grants to the railway companies. Of course, the mere authorization by the United States authorities is not sufficient to entitle the street railway companies to carry mail against the express provisions of the several ordinances under which they are operating.

The postal authorities in Chicago contend that the government has the right to use the railway companies' lines. One official is quoted as saying:

"If the city wants to test the matter of street-car lines hauling United States mail, I guess the government will meet it. Any interference on the part of the city would be regarded as an interference with the mails. The cable-car lines are post routes. The companies carry the mail on a contract. The federal courts have held frequently that the streets of cities are post roads under the contemplation of the act of Congress. As such, the mail of the government can be hauled over the streets, and, I think, the courts would hold that it is immaterial whether such hauling is by wagon or street cars."

The matter will undoubtedly be brought to an issue, as the labor organizations will press the advantage they have gained through the corporation counsel's opinion and probably endeavor to prevent the further operation of mail cars upon street railway lines. Considerable opposition will be provoked by such a policy, as the local mail service has undoubtedly been greatly improved by the use of the street cars for this purpose.

How Can We Increase the Efficiency of Our Employes? [1]

By W. W. Wheatley.

The term efficiency implies the existence of a standard of excellence. To speak of increasing the efficiency is only another way of speaking of a nearer approach to that standard. Briefly outlined, a high standard of railway service may be described as safe, regular, frequent, rapid, clean and comfortable. Any near approach to that standard will be found to depend largely upon the human element in the service.

In order to divest the subject of any uncertainty and to confine its consideration within definite limits, the writer assumes that it refers principally to those employes who operate cars; in other words, to conductors, motormen or gripmen. They are the employes who come into direct daily contact with the public, and whose bearing and conduct in the public eye is, to a great extent, the embodiment of the efficiency or inefficiency of the service rendered by the company. Our problem therefore is, How can we manage to secure in the personnel and in the conduct of our employes the nearest possible approach to a higher standard of service, public and private?

For the safe, economical and efficient operation of a railway there are three essential conditions:

First—A good track and motive power.

Second—An attractive and comfortable car equipment.

Third—Faithful, capable and well trained employes.

The first and second requisites may be obtained by a reasonable expenditure of money assisted by a high degree of mechanical skill. Money alone cannot buy the third requisite, because character and faithfulness, upon which alone conscientious, capable and trained service depend, must be cultivated and developed. Of course it pays to give a good price for brains, but brains alone will not make faithful, capable and well trained employes. Good material brings a high price, and intelligent men are worth more, because they are more likely to become competent than ignorant ones.

A simple and direct solution of our problem may be indicated under two headings:

First—Improve the personnel by the selection of better men.

Second—Improve their conduct and increase their faithfulness by a better system of discipline and training.

Let us consider first how we are to obtain better men. The man becomes the employe not entirely upon his own volition, but through the process of selection by one of the company's officials. Whatever official is charged with the duty of selecting conductors, motormen or gripmen bears a heavy weight of responsibility. To a large extent he is responsible for efficient service on the road, for upon him depends the selection of men who in their habits, education and tendencies are fitted for the work. Unfit men once in the service may become very grave factors in the attainment or non-attainment of good results. The very best mechanical and engineering talent is engaged at great expense for the purpose of selecting and testing the material used in the construction, repair and maintenance of roadway, power plants and equipment, and watching the results obtained from them. The utmost care is exercised before any device or material is selected for temporary or permanent use; but what methods do we pursue and how do we assure ourselves of the fitness of the men in whose hands are to be placed expensive property and human lives? Are they not often hurriedly selected to meet some pressing temporary requirement, or what is worse, are they not often permitted (without regard to their fitness) to enter the service at the behest of some politician whose friendship may become useful?

The officer who is to select the men should himself be selected with great care, and he should be protected from any influence likely to prevent him from selecting the best material. His field of choice will be limited largely by the wages paid to employes. If only such wages are paid as will suffice to command the services of inferior and therefore incompetent men, he should not be blamed for his frequent failure to select good men. No definite rules can be laid down for the selection of better men except to say that good character and fitness for the work should be the sole requirement for entry into the service. An ignorant, talkative blackguard should, under no circumstances, be permitted to enter, because he is not built right for the business, and by no system of discipline or training can a man of this character be fashioned into a gentlemanly, courteous employe. The writer believes it is best, as a rule, in selecting new and inexperienced men, to take those who have had more or less of mechanical training, either on the farm or in the workshop, provided, of course, they are suitable in other respects; and preferences should be given to married men beyond the age of 25, because, as a rule, they are more steady, reliable and more amenable to discipline. Professional floaters who go from place to place, often under assumed names, are always to be avoided. This branch of the subject is too large to be compassed in a few paragraphs. Suffice it to say that success in selecting good men is largely a question of being a good judge of human nature, aided by careful methods of looking up the antecedents of applicants.

To improve the conduct and increase the faithfulness of our employes, a better system of discipline and training is demanded. It is the policy of railroad managers to bring their equipment, track and power up to the highest state of efficiency, but do they know that their men have a clear and practical knowledge of their rules and of the proper operation of their equipment? Do they know that their rules are habitually observed, and that their equipment is operated in the manner prescribed?

Experience has taught the leaders of military organizations that it is one thing to make a rule or give an order, but quite another thing to know that it is enforced. They have learned that efficiency of discipline can be obtained only by close inspection, and it is so in railway service. Inspection should be made, not by secret-service detectives, but by trained inspectors, as is done in military organizations. In discipline, as in some other things, an ounce of prevention is worth a pound of cure.

Discipline consists not merely in administering punishment for offenses, but in a broader sense it consists in educating and training the men, so that it will not often be necessary to administer punishment. We may have the best roadway and equipment, but unless we are able to properly control and guide the intelligent human machines through whose agency results are to be accomplished, we may never have a high standard of efficiency.

Efficiency of service comes only as the result of long and persistent training, education and experience, and is therefore incompatible with short tenure of position. Is it not a conspicuous fact in street railway operation, that there is a comparatively short tenure of service of conductors, motormen or gripmen? Are we not continually discharging one set of men and employing new and inexperienced men to take their places, and if so, what is the underlying cause and what the remedy? Passing hurriedly over these very suggestive and interesting questions regarding tenure of position, it may be profitable to briefly review our present methods and opportunities of training new and inexperienced men.

In steam railroad practice, before a man is permitted to act as conductor or engineer in charge of a train with valuable property and human lives, he is subject to several years of education and training in one or more subordinate positions. Opportunity is thus afforded to study his character and temperament, observe his methods and measure his fitness for promotion, but in street railway practice there are, as a rule, no subordinate positions in which men are required to serve before being placed in charge of a car. New and inexperienced men are inducted into the service in large numbers, and after being schooled for a few days are given exclusive, absolute and independent control of a car running through crowded city thoroughfares and populous suburbs. Is it to be wondered at that costly accidents are the result?

It will be generally conceded that the position of motorman or gripman is a vastly more important and responsible position than that of conductor, as it concerns safety in operation. Why then should not all motormen or gripmen be required to serve an apprenticeship of three to six months in the shops or as conductors, during which time they could become perfectly familiar with the roadway, equipment and the rules and regulations, and during which time the officers could become better acquainted with them? After having served such an apprenticeship, would they not naturally be better qualified for the more responsible position? Men often blunder because they know no better. Some know they are ignorant and try to learn, while others do not try to learn. Some know they are ignorant and try to learn, but they do not know how, while there are still others who think they know it all and are entirely unconscious of their ignorance. In either case the officers of a road are more or less culpable if they do not take the measure of the men, and not only give them the opportunity to become competent but insist upon their becoming so before being placed in positions of responsibility.

But after all has been said about obtaining better men and training them to become more proficient in their duties, it still remains to make them faithful and attach them to the service. This point needs no emphasis when we remember the exactions of the service and the influences that are continually at work to degrade and mislead them, and prevent the proper and faithful discharge of their duties. There is no other calling which makes heavier demands upon the mental and physical endurance of men, and they should not be surrounded by demoralizing conditions which unfit them for the best service. Every company should take some interest in the social surroundings of its employes. They should be given some opportunities of enjoyment as well as self-improvement. We must remember that the chief end of their existence is not work, and when their work for the day is done we should offer them some counter-attraction to the street corner, the saloon or the gambling den. We should try to lead the men to feel that the company takes an interest in their welfare and wishes to improve their social condition. By so doing we shall more surely attach them to the service and make them more faithful and efficient.

Minor mistakes and blunders there will always be, but men do not as a rule make serious blunders with deliberate intent. In order to avoid blunders some incentive should be held out to make the men more careful. It is indeed questionable whether the fear of punishment is always the best incentive to offer, and yet how many of us offer anything else? The disgrace of suspension and the loss of wages may often be a deterrent, but what kind of an impression does it leave on the man's mind after it has been inflicted, especially so when it comes after a long term of faithful service? Well may we raise the question whether our system of discipline is not wrong, when we hold out no other incentive to efficient, faithful service than the fear of punishment.

Many of the principal steam railroads throughout the country are making a distinct advance in their system of discipline, which is more in keeping with the progressive, enlightened spirit of the age. They are trying to abandon the "master and man" idea and are seeking to attach men to their service by treating them like men and by giving some recognition and credit for varying terms of faithful, efficient service. Instead of fines and suspensions, which often beget a sullen, revengeful spirit, many roads are adopting what is widely known as the "Brown system of discipline, without suspension," which consists in keeping a debit and credit account with each man and advising him personally as the entries are made. Suspensions are made only nominally—that is, they are entered against the man's record, but are not actually enforced. George R. Brown, general superintendent of the Fall Brook railway, who first inaugurated this system, says concerning it in substance as follows:

> Penalties are imposed for two purposes: First, to uphold the law and prevent its further violation; and second, to reform the violator. Punishment inflicted indirectly benefits many who do not violate the law as well as the one who does. It often occurs that the disgrace and injury occasioned by a strict enforcement of a sentence does more to ruin the guilty than anything else, and a wise provision has been made allowing courts to use their judgment as to carrying out punishments; this is known as "suspending sentence." If the sometime offender does better and is not guilty of the same or other offenses, the judge conveniently forgets the indictment hanging over him, but should he go on committing one misdemeanor after another his record rises up to condemn him. I believe in the practice of suspending sentence with railroad employes.

Under this system a man's position depends on his record, and a long term of faithful service entered to his credit counts for something every time the account is balanced. That is undoubtedly the correct principle which teaches the employe that he will as surely receive credit for his good work as that he will be charged with his errors and faults, and he will certainly become a better man when he learns that his final success depends solely upon the record that he makes. The writer suggests that it may be possible to embody into practical methods adapted to street railway service the principle herein briefly outlined, but it should be undertaken only by those who are in sympathy with it, and whose experience in dealing with men has fully convinced them that harshness is less powerful than kindness, and that just, humane treatment of men will bring about a closer relationship and more perfect confidence between employer and employe.

1. Read before the New York State Street Railway association, Niagara Falls, N. Y., September 14, 1897.

Illegal Taxation of Poles.

In the case of the city of Saginaw against the Swift Electric Light company, the question was raised as to the reasonableness and legality of a charge for the inspection of poles. The City Council had passed a general ordinance intended to regulate the placing and putting up and taking down of electrical wires and cables and the placing of conduits therefor in the streets, alleys and public spaces of the city. Section 19 of this ordinance read: "The city of Saginaw shall cause all poles used and maintained and occupied by any person, company or corporation for stringing or sustaining his or its electrical wires or cables in said city to be inspected once each year, to ascertain whether the same are secure and maintained in accordance with this ordinance of said city, and such person, company or corporation shall pay to said city for such inspection the sum of 50 cents per annum for each pole so maintained by him or it." The electric light company was organized under the general statute of the state of Michigan, giving it the right to do business under "such reasonable regulations as the municipal authorities may prescribe." In pursuance of the section of the city ordinance quoted, all of the poles on the east side of the city of Saginaw were inspected by a man employed under the direction of the Common Council and the Board of Public Works. He inspected in all 3,072 poles, of which 1,045 belonged to the electric light company. He spent 66½ days doing this work, and received $2.25 a day for his wages, which made the cost per pole about five cents, so that the actual cost of inspecting the defendant's poles was $52.25, while it was to be charged $522.50 therefor. It appeared further that the defendant company had inspected its 1,045 poles in three days, and that two men went over the entire line every day and inspected the poles and trimmed the lamps, which were on 158 of the poles. It also appeared that it had been assessed $15,000 upon its real estate and $40,000 on its personal property, which included the poles. Under these circumstances the Supreme Court of Michigan held the ordinance unreasonable and invalid. The court says that while it thinks it proper for the city to make a reasonable inspection, and it is not prepared to say that this was not a reasonable one, there is no occasion for requiring the electric company to pay more than a sum sufficient to pay the reasonable cost of such inspection.

Wagner Alternating Apparatus.

For years the Wagner Electric Manufacturing company of St. Louis has been identified in the closest manner with the development of electrical apparatus. Starting in a conservative way, this concern has kept continually increasing its plant until it now occupies one of the finest factories in the United States for the production of its varied product. As the alternating apparatus branch of this company's business, however, is the one through which it is best known, the accompanying cuts are of interest in that they present a good idea of the variety of types of the company's product.

With reference to self-starting single-phase alternating current power motors, the Wagner company states that pressure is being constantly brought to bear on owners of stations to induce them to throw away their single-phase apparatus and install instead polyphase apparatus. The assertion is made that no alternating current central station can be made to pay until a day load is secured, and that with single-phase apparatus, such a day load cannot possibly be secured, for the very simple reason that "there are no commercially successful single-phase alternating current power motors." Such an assertion, the Wagner company claims, is now a flat contradiction of fact, for it has had in operation for many months, undergoing the most severe tests to which power motors are ever subjected, single-phase, self-starting induction motors. The principle of the motor is extremely simple, there being a primary and a secondary element, bearing the same relation to each other as the primary and secondary coils of a static transformer. The primary constitutes the stationary element corresponding to the field of a direct current motor. The secondary is the movable element, corresponding to the direct current "armature." This secondary is constructed to operate in a double way. For starting, it is thrown in series with the primary by means of carbon brushes running on a commutator. With this connection the operation of the motor is in every essential feature exactly that of a series direct current motor. On attaining the running speed the connections are simply changed, the commutator, in the operation of changing, being completely short-circuited and the carbon brushes lifted off. The motor then runs as a non-synchronous induction motor. These motors are not affected by switching at the station, nor is their operation interfered with by the interrupted electromotive force on the line. As they are induction motors, they do not run in synchronism with the generator at the station and do not experience the unfavorable condition of what is known as getting out of step with the generator. They further will not slow down and stop when a heavier load than normal is applied, as is the case with the synchronous motor, but when the excess load is discontinued will pull up to normal and continue the same as before. An illustration of the motor is presented herewith. Fig. 1 shows the general mechanical design. The very rapid rise of the efficiency curve on light loads is a significant feature. Not less noticeable and noteworthy is the high efficiency maintained up to the point of 50 per cent. overload. This small drop in speed with increased loads is a further point of superiority, while the high power factor at all loads is a characteristic unprecedented in motors of this capacity. It is possible to pull up from rest double the rated load of the motor with a current only exceeding the load current by 50 per cent. The motor very quickly runs up to the load-service speed, and operates under any and all loads with smoothness and quietness. Another feature which will prove most attractive to the central station man is that there are no pulsations of current with this motor. The motor is also absolutely unaffected by momentary interruptions in the current supply or a sudden change in frequency or voltage, resulting from necessary station switching.

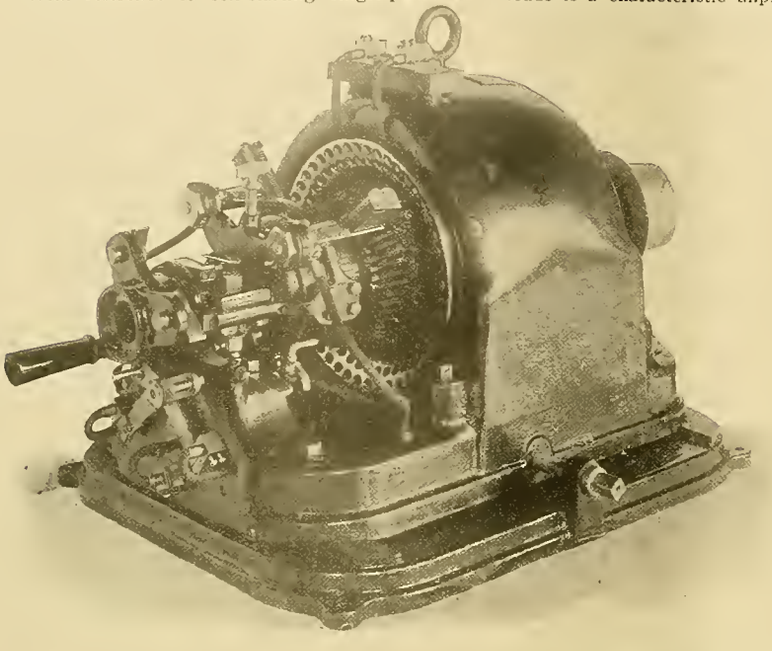


Fig. 1.

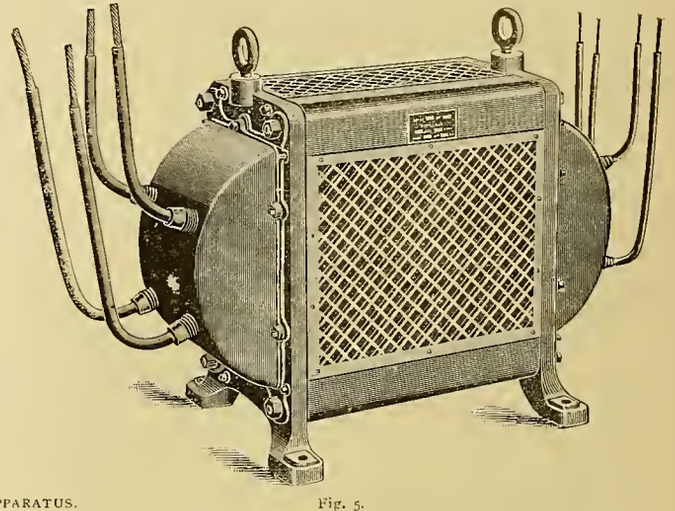


Fig. 5.

WAGNER ALTERNATING APPARATUS.

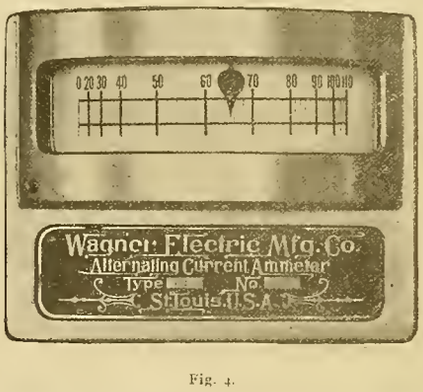


Fig. 4.

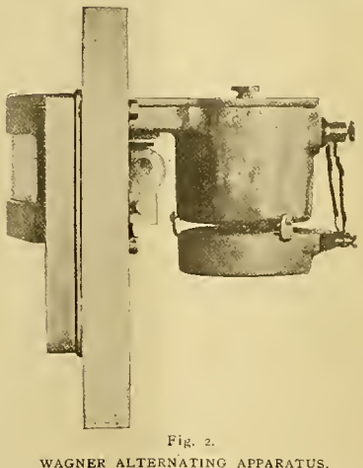


Fig. 2.

WAGNER ALTERNATING APPARATUS.

Fig. 3.

The frequencies generally found in single-phase stations are 16,000 and 7,200 alternations per minute. This design of motor is guaranteed to operate with equal effectiveness on either.

One of the needs in alternating current central station equipment has been a reliable dead-beat, wide-scale, indicating switchboard instrument. This company has developed a line of indicating voltmeters, ammeters and wattmeters which it claims meet every requirement. These instruments are a radical departure in design, both mechanically and electrically. The moving parts are carried on a vertical shaft, the lower point of which runs in a jewel bearing. This point is at all times immersed in oil, and, accordingly, friction is reduced to a minimum. The deflecting force is so very great that every point on the scale has a positive differential value, and successive deflections, with the same deflecting force, are absolutely the same. Furthermore, the inductive error is eliminated, voltmeters, for example, reading practically the same on direct curent as on alternating current of 16,000 alternations. Finally, every scale is accurately plotted by independent calibration, and as there are no parts the constant of which is subject to change, indications are permanently reliable.

In the Wagner instruments, Figs. 2, 3 and 4, the oscillating of the indicating needles has been wholly eliminated by floating all the moving parts in a light, colorless, odorless oil, a couple of small aluminum vanes serving to afford a dashpot action by which needles are held stationary against any passing, instantaneous disturbance, and at once brought to rest on throwing over. That the instruments are economical in operation is apparent from the statement that the voltmeter consumes but seven watts on 110 volts pressure.

Admirable provision has been made for illumination of the scales; the lamps, two in number for each instrument, are eight candle power, 50 volts each, connected two in series and mounted on a special bracket which holds them in the necessary position. The body of the instrument, which extends through the board, is highly japanned in black. The front cover is of polished brass. Provision is made to keep all dust out of the instrument. The oil is carried in the cup forming the rear portion of the body. The cover to this portion is removable, affording easy inspection and filling of cup with oil. The ammeter is identical in general appearance with the wattmeter and voltmeter, but the principle employed is somewhat different. In instruments up to 100 amperes capacity the entire current of the circuit is sent through the instrument coil. Above 100 amperes use is made of a series transformer, the primary of which is cut in on the bus-bar. In the voltmeter movement use is made of the dynamometer principle. The scale, being one of 67 degrees arc, is almost absolutely uniform throughout the range. Scales can be plotted to any value desired, from zero to the maximum called for, or from any specific point to the maximum. The maximum pressure of operation is 150 volts. Above that point step-down transformers are furnished.

In the wattmeter the dynamometer principle is again employed. The pressure coil is connected to the 100 volt ends of a step-down transformer. The series coil, for circuits of 25 amperes, takes the entire line current. Above that amount a series transformer identical with that used for ammeters is employed.

Figs. 5, 6, 7 and 8 show respectively the Wagner 500 light indoor type transformer, the 100 light type D transformer with bracket fuse boxes, the Wagner XL fuse cut-out box and a glimpse of a line of the company's step-up transformers, 600 kilowatts, 10,000 volts, water jacketed.

The Wagner transformer is the result and embodiment of several years' experience in the use of transformers in one of the largest existing sta-

tions. High and practically indestructible insulation, though costly, is obtainable, and such material, the company states, is used throughout in its transformers. It has been the company's purpose further to effectually guard against heat effects and electrical strains. To such a high degree of perfection has this been carried, that every transformer readily withstands 10 times the normal primary voltage, impressed between the primary and secondary coils. Standard transformers are tested with a pressure of 10,000 volts alternating current between primary and secondary and between primary and the iron core. An insulation test is made between the secondary and the iron case and the iron core of 6,000 volts. The company is therefore ready to guarantee transformers against burning out from any cause, except overload, fire or mechanical injury, for a period of two years from date of purchase. Leakage or magnetizing current constitutes the principal loss or waste in the transformer, and therefore demands the most careful consideration. On account of hysteresis, this leakage current is dependent to a large extent on the quality of the iron employed, and may therefore differ considerably in two transformers in all other respects identical in design. The iron used in Wagner transformers is made by one manufacturer expressly for them. Owing to this careful selection of iron and to an ingenious device in the design, transformers are produced differing from one another in characteristics and efficiency by an incredibly small amount. The Wagner company believes it has discovered the causes of the ageing of transformer iron, and has succeeded in determining a formula for the preparation of the iron by which the causes of this change are eliminated. Step-up transformers are now being introduced to a large extent for long-distance transmission. These step-up transformers, being used in large units, are very efficient, and render such service very satisfactory. The company makes

New Railway Motor.

In line with the "G E 52" and "G E 1000" railway motors the General Electric company announces a third, the "G E 57." This is called forth by the success and popularity of the "G E 1000," to which it is similar in design but of greater capacity, while still as compact and simple. It is intended

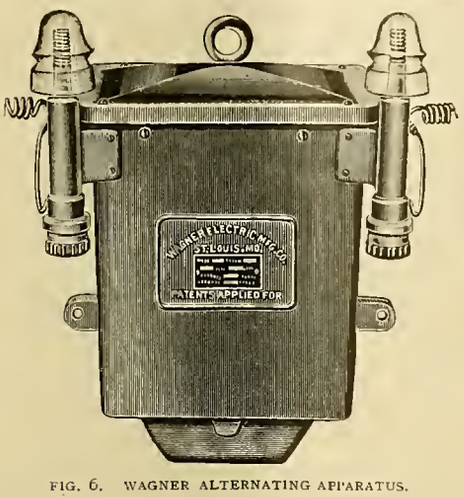


FIG. 6. WAGNER ALTERNATING APPARATUS.

for heavy city and suburban work, and is suitable for service of that class either as a two or four motor equipment.

Rating.—The "G E 57" has an output of 50 horse power at 500 volts, rated according to standard General Electric basis, a maximum rise of 75° C. in the temperature of the windings after a run of one hour at rated load, the temperature of the surrounding air not exceeding 25° C.

Frame.—The frame is of similar construction to that of the "G E 52" motor. It is steel, cast in two bowl-shaped pieces, with a hand-hole in the lower half directly beneath the commutator. This permits free access to the bottom of the motor for inspection or cleaning. The frame is both water and dust proof, the cover plate of the top half being provided with a felt gasket and clamping bolts as in the "G E 1000" motor. The motor has four laminated poles, each having a separate coil held in place by the pole-piece, which is bolted to the frame, the bolts projecting through the frame with nut and lock washer on the outside.

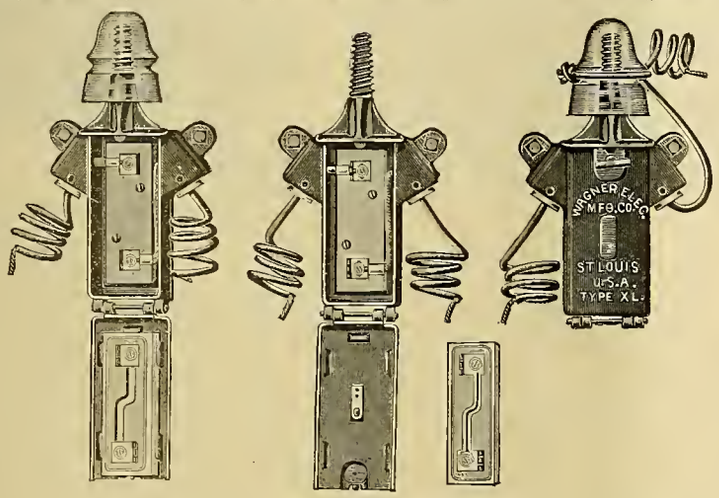


FIG. 7. WAGNER ALTERNATING APPARATUS.

these in standard sizes from 100 lights to 3,000 lights capacity—for 4,000, 5,000 or 10,000 volts.

The XL fuse cut-out box is a comparatively new form. It is adaptable for use on primary circuits of transformers as a protective device against short-circuiting or overloading, or for primary distributing circuits as a protective or switching device. It is waterproof, affording perfectly safe replacing of fuses on live circuits, and assures reliable blowing of fuses. On opening the box, the lid comes forward and down, the top porcelain block containing the fuse drawing out with it. In this way the opening of the box breaks the circuit. The porcelain block containing the fuse is still further removable by simply drawing out from the end

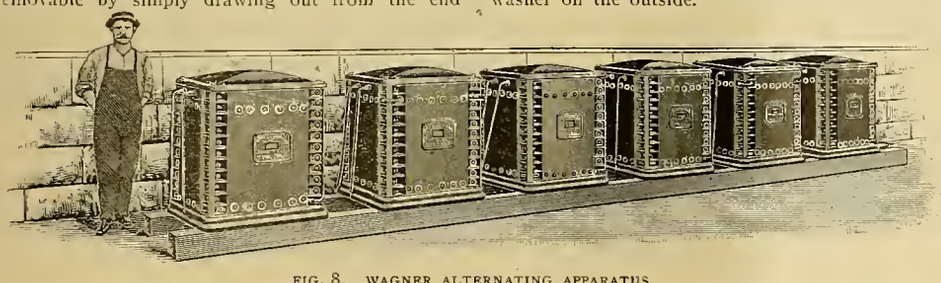


FIG. 8. WAGNER ALTERNATING APPARATUS.

of the lid, thus entirely detaching it from the box. The resistance to this removal is a spring between the block and the lid, so constructed as to prevent the block sliding out by its own weight.

The porcelain parts fit closely together, the spring in the lid serving also to press the upper half down on the lower half. A rubber gasket completes the perfection of the joint.

It is proposed to lay a cable to connect Iceland with the North of Scotland, but it is likely that financial and other difficulties will prevent the execution of the scheme.

Bearings.—Knowing the amount of trouble that has been experienced by street railway companies from small motor bearings and their poor lubrication, the bearings of this motor have been designed with special reference to these points. The armature bearings are of the following dimensions: Pinion end, 3¼ by 8¾ inches; commutator end, 2⅞ by 6⅜ inches. They are designed and built on the "outboard" plan. The support for the upper half of the lining is cast as a part of the upper half of the frame, and between the inner end of the outboard bearing and the motor frame there is a large cored recess. This space is utilized for a combination thrust collar and oil guard, which is funnel-shaped and extends through the motor frame into the cored recess, where it acts as an oil guard, eight inches in diameter. The support for the lower half of the lining is a cap bolted to the upper half, but not inclosing the lower half of the oil guard. This allows free egress to the lubricant after it has passed through the bearing and makes it impossible for it to work through into the motor frame. Either oil or grease may be used in the bearings. The lower boxes, or oil wells, are provided with felt wicks, which wipe the shaft through holes cut in the linings. For the armature bearings there are two of these wicks on the pinion end and one on the commutator end. For each of the axle bearings there are two wicks.

Field Coils.—The coils are wound on cast spools thoroughly insulated with asbestos, mica and paper and wound with copper ribbon insulated with asbes-

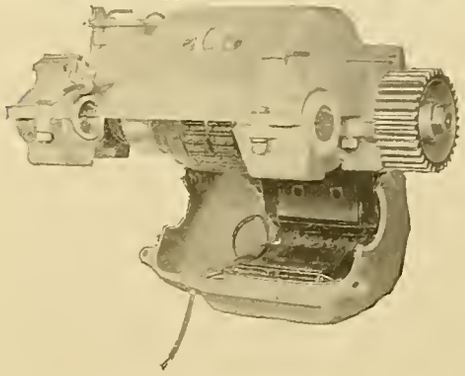


FIG. 2. NEW RAILWAY MOTOR.

tos. A covering of heavy duck, drawn together and sewed after the spool has been wound, forms a perfect mechanical protection for the winding. As in the "G E 1000" motor, the upper and lower field connection is made on the outside of the motor, and all leads to the car are brought out on the front end. This has been found convenient in the car wiring and opening of the motors.

Armature.—The armature is similar in construction to the "G E 52" armature. It is small and compact, being 14 inches in diameter, with a spread of 12 inches, and has 33 slots. It is ironclad, the core being built up of well annealed laminated disks assembled directly on the armature shaft. In assembling the core, three sets of spacing blocks are used, providing three ventilating ducts. This form of construction is similar to that of the large generator armatures of the General Electric company. There are 33 triple coils; each coil composed of three separate coils bound into a compact single unit. The separate coils are wound with either two or three turns per coil, as may be specified, the three-turn winding being standard for ordinary service. This method of winding is a distinct advantage in the matter of armature repairs, there being comparatively few coils to look after, while the construction admits of a substantial insulation of high quality, insuring immunity from repairs. A special effort has been made in the design of this motor to have the armature as light as possible without detracting from its electrical merit and efficiency, a light armature having small inertia presenting special advantages in starting and braking.

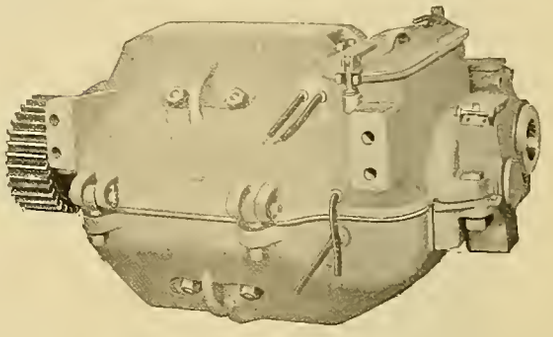


FIG. 1. NEW RAILWAY MOTOR.

The standard gear ratio is 3.72, with a taper-bore pinion having 18 teeth, and a cast-steel gear having 67 teeth, and a face of five inches. A two-motor equipment with this ration will propel an 18-ton car about 26 miles per hour on level track. For heavy haulage work a lower speed gear ratio may be used, giving a slower speed and correspondingly increased tractive effort. A higher speed gear ratio may also be used, giving an increased speed and correspondingly decreased tractive effort.

Commutator and Brush-holders.—The commutator is similar in construction to the "G E 1000," and has 99 segments. The segments are of hard-drawn copper two inches deep, allowing a wearing depth of one inch. The brush-holders are staggered to prevent the wearing of ridges in the commutator, and each holder contains two radial brushes 2¼ inches long by 1¾ inches wide by ⅝ inch thick.

Suspension.—The standard "G E 57" motor is adapted to either the nose or the yoke suspension, as in the "G E 1000" or the "G E 52" motor. The motor can be fitted for side-bar suspension, but this necessi-

tates a slight modification of the frame. The yoke suspension is recommended, as with this suspension the weight of the motor is carried on springs placed on the side frames of the car trucks. Lugs are cast on the upper half of the motor frame, to which the suspension bar is bolted. For inspection or repairs, the lower half of the motor can be swung down into the pit without disturbing the upper half. When the motor is mounted on 33-inch wheels the clearance between the bottom of the motor and the top of the track rail is 3¼ inches. The clearance between the bottom of the gear case for 67 tooth axle gear and the top of the track rail is 4⅛ inches.

Weight.—The "G E 57" motor without gear or gear case weighs 2,632 pounds. With 67-tooth gear and gear case the weight of the motor complete is 2,972 pounds.

The cuts show the front end of the motor (Fig. 1) and with lower frame dropped to show the armature in position (Fig. 2).

Puritan Alternating Arc Lamp.

The cut shows the arc lamp manufactured for alternating current circuits by the Puritan Electric company, 150 Nassau street, New York. Central station managers will find, it is claimed, that faults and failings of the old open arc have been remedied, and the difficulties encountered in the application of arc lamps to alternating current circuits have at last been surmounted.

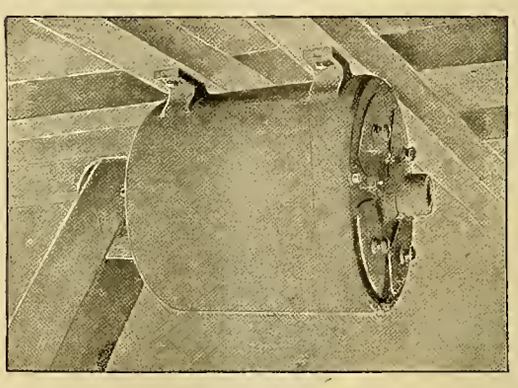
This lamp is designed to burn upon a secondary voltage anywhere between 90 and 120 volts, and taking six amperes of current the total wattage of the lamp will range between 400 and 450, of which all but 25 watts is actually consumed at the arc in producing light. The mechanism is simple and not easily deranged, and 100 hours' life is obtained from two 7½ by ½ inch carbons, the upper and lower carbon being of the same length.

It is adaptable for use for both inside and outside lighting, and the humming and buzzing common to the old alternating arc have been entirely eliminated making it unobjectionable in even the most confined quarters, while its short length makes it adaptable to the lowest ceilings.

No special transformers or economy coils are necessary, and the lamp is entirely self-contained and burns in multiple.

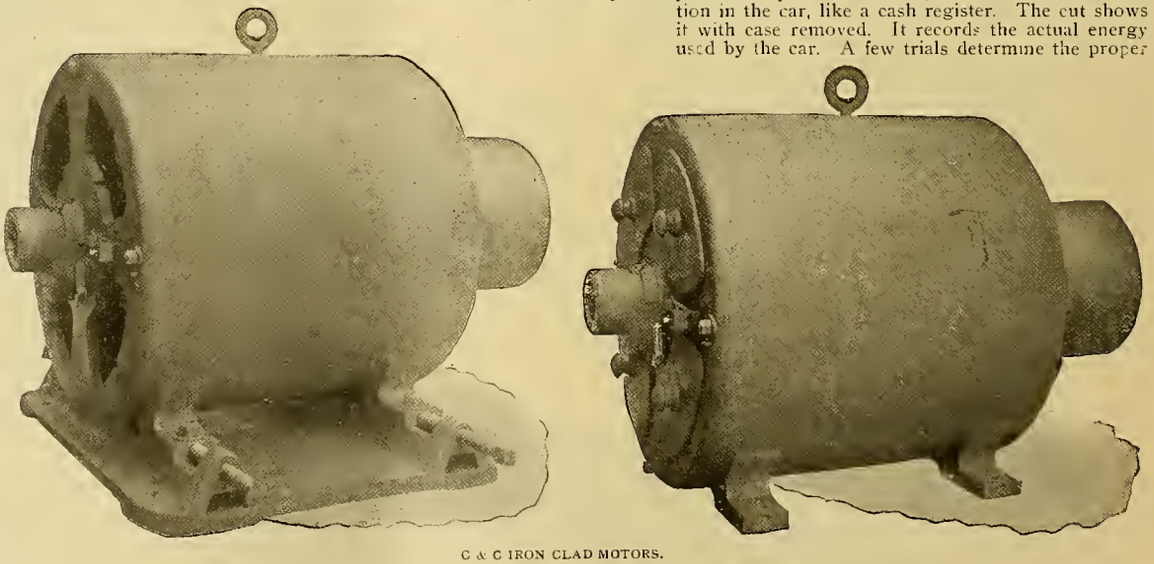
C & C Iron-clad Motors.

The C & C Electric company of New York claims for the motor illustrated herewith a wider range of application than any other type on the market, as it can be belted, back-geared, direct-connected or furnished with change gears to drive at a range of speeds; it can be run in any horizontal position whatever, inverted or otherwise, is dirt and dust-proof and has a high efficiency under all the above conditions.



C & C IRON-CLAD MOTORS.

PURITAN ALTERNATING ARC LAMP.



C & C IRON CLAD MOTORS.

The frame consists of a soft steel shell with radial poles projecting inward; the shell is capped at each end with a circular end-plate which carries the bearings and also the rocker arm support. The magnetic circuit of this machine has four poles and magnet coils, and the coils may be readily removed after taking out the armature and are interchangeable.

The armature is of drum type, built up of thin laminæ of soft iron, well insulated to provide against Foucault currents, and having the conductors laid in slots, the coils being wound on forms. The commutator is of generous proportions with ample brush surface. The brush-pin support is designed to secure mechanical rigidity and to avoid humming noises. The brush holders are of the well-known reaction type, securing a flexible and even pressure of the brushes with a minimum wear, and of such design that the brushes maintain a constant relative position on the commutator, thereby providing against the necessity of shifting the brushes forward when they have been shortened by wear.

The bearings are self-oiling, with oil wells of a large capacity, thus providing an ample quantity of clear oil for lubricating purposes. The shaft is of best steel and of such proportions as to insure rigidity and ample carrying capacity. The cylindrical form of this machine makes it well adapted to all cases of direct connection, either through gears or otherwise. The gear shaft boxes can be placed on the shell at any convenient position, as the distance from the shaft to the outside of the shell is always the same. The machine itself can be placed in any horizontal position, thus making it well adapted to run as a ceiling motor, or attached at any angle to an "A" frame, or to bolt to the bedplate of any machine or tool with which it may be combined; the circular form of the endplates allowing them to be bolted on always with the oil wells in the proper position.

The iron-clad magnetic field, the manufacturers claim, is ideal in its compactness, its circuits of minimum length and its freedom from "external field" or magnetic leakage, all of which qualities effect a saving in magnetizing force, and consequently a gain in efficiency. While improving on the ordinary type by providing an iron-clad type of field, the outer shell also forms a protection to the motor, making it especially valuable where dust or dirt or dampness are apt to occur, and, in fact, anywhere where employes are liable to be careless with reference to the motor. It will be noted that on this motor neither the commutator nor none of the moving parts, except the pulley, pinion or coupling, are outside of the shell, which secures safety not only to the operator, but also to the armature of the machine. As the shell is of steel, five-eighths inch or more thick, it may be tapped into wherever desirable, as in a case of direct application to machine tools or other classes of machinery, provided iron bolts are used, thus making the motor form part of the framework as well as the driving power.

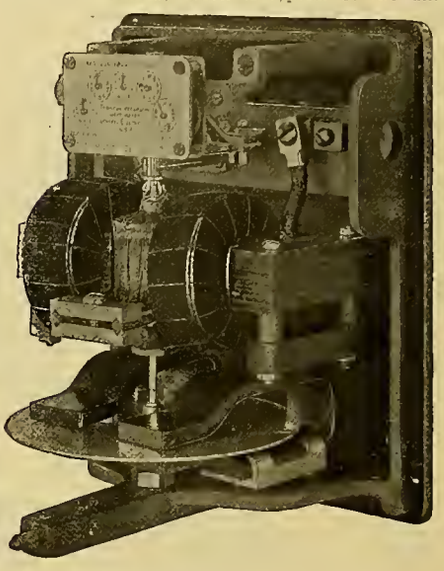
The construction of the armature, while making it a beautiful winding, has also the mechanical advantage that it can be handled without danger to the winding, the conductors being below the surface of the armature. The motor is guaranteed to deliver the full rated horse power at pulley, pinion or coupling in continuous service. No part of the armature conductors, field conductors, brushes or commutator, the C & C company further states, will show a heat of more than 50° C. above the surrounding temperature. The efficiency claimed is from 85 to 92 per cent., depending on the size of the motor.

This machine can be furnished, first, with speed regulation by means of a field controller, giving a speed range of from full speed down to two-thirds of full speed, with a proportionate output (this avoids the use of series controllers where they may be objectionable); second, back-geared to any desired speed, making it a very compact and efficient motor driving at slow speed; third, with back shaft and change gears, making it possible to obtain a range of speeds on the driving shaft by changing the gears, requiring only a moment's time and involving the use of no rheostats whatever.

Quite a number of this type C & C machines have already been introduced by the company' western manager, Martin Insull, in Chicago, and throughout the West.

Recording Wattmeters for Street Cars.

The adoption of more careful and accurate methods in street railway work is typical of the universal struggle for economy. The advantage of exact measurement of station output has long been recognized, and the requisite meters provided, but to record the ever-varying energy used on a car traveling over all conditions of road involves difficulties almost unsurmountable. In the Thomson recording wattmeter for street railway service, the General Electric company claims, however, to have overcome all the obstacles. The new meter, which has been placed on the market after a number of years of experimental work, is intended for installation in the car, like a cash register. The cut shows it with case removed. It records the actual energy used by the car. A few trials determine the proper energy consumption per car per trip under various conditions of track and traffic. Subsequent readings of the meter determine at once if energy is wasted, and thus serve as an effectual check on the motorman and condition of the motors.



RECORDING WATTMETERS FOR STREET CARS.

Experiments are said to prove that meters on lighting circuits increase the lighting capacity of the station by nearly 30 per cent.; that is, 30 per cent. of the light used when the contract plan is followed is generally wasted. Many railway managers agree that the average waste due to carelessness of the motormen amounts to not less than 20 per cent of all the energy generated. The economy, therefore, which will be induced by the use of street-car meters will mean a saving of half of the average waste, or 10 per cent. of the total energy generated. The profit from such economy is two-fold. It saves, first, the cost of coal and

water necessary to generate one-tenth of the total energy output of the station, and, second, it increases the receipts by increasing the car capacity without enlarging the station, or, in other words, it enables the station manager to operate 10 per cent. more cars without increase in the station equipment.

Car meters used in connection with station meters supply a system by which the detailed and combined efficiencies of a station are directly obtained and an account given of the energy developed by every pound of coal consumed in the station. The adoption of such a system will, by necessity, increase the efficiency of any station under intelligent management, since it reveals and locates with unfailing accuracy any causes of wasted energy.

The simple motor construction of the car meter, as shown in the accompanying illustration, is similar to that of the other forms of Thomson recording wattmeter, but new conditions imposed by the rough service have been met by the careful design of the rotating parts. Unavoidable vibration, due to rough tracks, demands a low drop in the armature in order that contacts may not be injured by sparking. High torque is also a requirement, so that heavy brush pressure insuring perfect contact can be used. The sudden and wide variation of current requires a meter that will start quickly and slow down as soon as the current diminishes. The General Electric company claims high accuracy for its new car meter and ability to withstand severe and continued use on the roughest tracks. The meter is now made for 500 volt circuits in sizes for 25 or 50 amperes, with a liberal provision for overloading.

Electric Railway to Be Built in Sicily.

Mr. L. H. Bruhl, the consul of the United States in Catania, Italy, thinks that there is a chance for the use of American apparatus on the street railways to be built in that city. Catania is a city of nearly 125,000 inhabitants on the eastern coast of Sicily, and it has a considerable coasting trade. An electric railway system is to be built, and a proposition to the City Council has been made by Berlin capitalists, who have been on the ground, accompanied by a practical engineer. But the German offer may be rejected. Says Mr. Bruhl: "Fratelli Prinzi (steam millers) are quite hopeful of receiving the concession or charter, although the Berlin company is working very hard. Should the former win, they will purchase the material, rails, wire, cars, dynamos, etc., and construct and operate the line themselves in connection with their steam mills. This firm promised me last year, and renewed their promise a few days ago, that they would give American manufacturers an equal chance to supply the plant, but expressed surprise that no offers had been made to them as yet, nor had any illustrated catalogues been sent from America, while they have quite a number of such coming from other countries. Public sentiment is in favor of foreign capital, fearing that the Catania projectors have not sufficient capital to construct a line which would be a credit to the city, while the Berlin company has built lines in a large number of cities. As soon as I noticed that the tramway question was being pushed in earnest I endeavored to learn whether or not there would be any chance for American manufacturers. On account of the distance at least two months would elapse before Americans could act, but I hoped the Catania firm would gain the fight, and then our manufacturers, if they acted at once, would have time to put in their bids. I kept in communication with a leading member of the City Council regarding this matter, and have just now been favored with a letter from him, informing me that the proposals will not be taken up and acted upon before the second half of November, at the earliest, and that therefore American companies would have ample time, if they acted at once, to study the ground, make their plans, present such, together with illustrations of their plants as existing, and enter into competition with the other projectors. An American street railway in Catania would be a great standing advertisement for American industry, and an entering wedge for our commerce with Sicily, especially in machinery, tools, etc."

Acceleration Tests.

A series of additional train acceleration tests was made on October 7th on the experimental track of the General Electric company at Schenectady, in the presence of A. W. Sullivan, general superintendent, W. Renshaw, superintendent of machinery, and John Lundie, consulting engineer of the Illinois Central railroad, and E. C. Carter, principal assistant engineer of the Chicago and Northwestern railroad. Although the weather was most unfavorable and the runs made in a heavy downpour of rain, the results recorded were pronounced very satisfactory. The tests were made more especially for the purpose of giving to the railroad men a clearer comprehension of the adaptability of electric traction, and of securing that acceleration from rest which would satisfy the demands of a congested suburban traffic such as that with which the Illinois Central Railroad company has to cope in Chicago.

The car used on the occasion of these tests was a standard elevated railroad car, weighing empty about 25 tons. It was equipped with four 50 horse power motors, one mounted on each axle, controlled by a standard series parallel controller. In order that the officials present should be able to witness the actual performance of the car, the interior was equipped with voltmeter, ammeter, recording wattmeter and compensated chronograph, with bell attachment sounding at two-second intervals. Attached to one axle was a Boyer speed recorder, with the gauge on a level with the window.

The car was driven by W. B. Potter, chief engineer of the railway department of the General Electric company, and the tests were made under his direct supervision. A series of 14 runs was made on the tangent of the experimental track—a stretch 3,000 feet long—and the results on the wet track showed that in five seconds the car holding 20 people reached a speed of 19 miles per hour; in 10 seconds, 30 miles per hour; in 15 seconds, 35 miles per hour, and 41 miles an hour in 20 seconds. This was with a wet and greasy track. During the latter half of the test the rain ceased and a second series of tests was made with a dryer track. The results were more favorable, and a speed of about 41½ miles an hour in 20 seconds was obtained.

Perhaps a better idea of these results may be conveyed by saying that an ordinary elevated steam train would reach a speed of about 14 miles an hour in the same lapse of time, while it would be only possible to accelerate it to the same speed in the same space of time by starting it on a down grade of about 15 per cent. The significance of such acceleration may still better be grasped by the fact that it would mean a saving of not less than 15 minutes in the running time over a distance of 10 miles, with the same number of stops as in ordinary suburban or elevated service.

The tests are to be continued at Schenectady under varying conditions; that is, with different weights of cars and different equipment. The need of electricity on certain branches of the traction service of roads now operated by steam is becoming more urgent, and although it is perhaps premature to predict any immediate revolution in steam road methods, the encroachment of electricity in that domain can no longer be denied.

Women in Electrical Factories.

The Bureau of Labor has recently completed a tabulation of statistics relative to the employment of women in various industries in place of men, and the effect the employment of women had upon that of men. One of the subjects of the investigation was to learn whether the employment of women in the making of electrical goods was increasing. The information gathered on the subject is meager, statistics being given for but three states in the Union. Manufacturers of electrical apparatus in Illinois report that the number of women in their employment has steadily increased during the last 10 years and is continuing to increase year by year. Women were first employed in this industry in 1881 in this state. In Connecticut manufacturers report that the number of women employed in the industry is not increasing. Women were first employed in that state in 1880. Maryland began to employ women in 1879, and reports that the number is increasing. The reasons given for employing women are that they are cheaper than men and at the same time are more careful, more quiet and easy to control, and consequently less likely to strike; they are not intemperate, and are, in the opinion of the employers, better adapted to certain classes of work.

CORRESPONDENCE.

New York Notes.

New York, October 12.—The Appellate Division of the Supreme Court has given the Special Commission of Inquiry on Rapid Transit until November 8th to file its report. This is the second extension of time granted the commission since its appointment two months ago. One of the witnesses of last week was F. S. Gannon, first vice-president and general manager of the Southern railway, who testified that at one time he was general manager of the Staten Island Rapid Transit system, and in detail gave the rates of travel on the roads as they were then operated. Express trains of six cars each on the proposed underground railway could, he said, be run at a 36-mile-an-hour-gait. He calculated that on the schedule laid down in the plan the local and express trains, running respectively at one and two minutes headway, would carry from one point to another 32,000 passengers per hour. He said he believed that a higher rate of speed could be maintained by trains in the underground railway than is at present maintained on either the Third or Sixth avenue elevated railroads.

W. T. Manning of Baltimore, who was engineer in charge of the Baltimore and Ohio tunnel during its construction, was called. He testified in reply to Mr. Boardman that he was engineer of the Staten Island Rapid Transit railroad, and also assisted in the construction of the Baltimore tunnel. Mr. Manning said he had traveled over the entire route in the city and found just as much obstruction at certain points caused by the tearing up of the streets as would be met with if the proposed underground road was in course of actual construction. He agreed on the whole with Mr. Parsons' plans, and the estimate of the cost be considered ample.

Howard A. Carson, chief engineer of the Boston Rapid Transit company, told about the Boston underground route. He thought that the estimates of cost of construction made by Mr. Parsons, the chief engineer of the Rapid Transit Commission, were generally liberal.

Controller Fitch was called and testified that on August 31st of this year, when the last accounting was made, the amount of city cash in the treasury derived from the sale of bonds was $9,901,763.49. In regard to the amount the city could afford to spend within 10 years for rapid transit purposes without bringing the city debt any nearer its limit than it is at present, Mr. Fitch was not prepared to say definitely.

Wheeler H. Peckham, the well-known lawyer, gave testimony about the Boston underground railway, which he had inspected while on a visit in that city recently. He described it as being as charming and admirable a method of travel as anyone could desire. "The air," he said, "was as perfect as could be desired; there was no dampness, and the tunnel was sufficiently lighted with incandescent and arc lamps. My general impression was and is that if we had that kind of rapid transit here there would be no occupation for objectors."

The report of the Metropolitan Street Railway company for the year ended June 30th gives the following figures: Gross earnings, $8,888,804; operating expenses, $4,810,235; net earnings, $4,078,509; other income, $547,529; fixed charges, $3,186,975; net income, $1,439,122; four per cent. dividend declared on $30,000,000, amounting to $1,200,000; total surplus, $1,332,488; cash on hand, $295,013; number of passengers carried, including transfers, 234,705,704; transfers issued, 56,929,611. The net earnings of the company for the year were increased by $98,690 as the result of interest on investments by the Metropolitan Street Railway company formerly paid into the treasury of the Metropolitan Traction company. During the year 16 passengers were injured and two killed; two employes were injured and two killed, while 19 persons not passengers or employes were injured and eight killed.

A new charge is made against the Metropolitan company to add to its other troubles. Application has been made for a writ of mandamus directing Commissioner Collis to put a stop to what is alleged to be a scheme of the Metropolitan Street Railway company to secure without authority of law privileges of enormous value. The application for the writ has been made by Meyer Lehman, through his counsel. Mr. Lehman alleges that the Metropolitan company, in all the streets in which it is now installing the underground trolley system, is also constructing, in a practically surreptitious manner, a complete system of electrical subways, by means of which it will by-and-by be enabled to conduct a general electrical business throughout the city. The allegation is made that the terra cotta conduits which are being laid, one row on each side of the track, along all the line of the "new work," and which contain each from 12 to 15 holes, of an interior diameter of three or four inches, are 18 to 20 times as large as is necessary for the accommodation of the feed wires and other wires essential for the equipment and operation of the proposed underground trolley railway lines, and are several times as large as the subways authorized to be constructed under the company's permit. The company which now constructs and operates subway conduits as the agent of the city, it is set forth, receives $1,000 a mile annually for a three-inch cable, or from $12,000 to $20,000 a mile annually for the use of conduits of an aggregate capacity equal to that of the conduits which, it is alleged, the Metropolitan company is now constructing in many places along the 45 miles of new tracks which that corporation is now putting in; which conduit space, if it should hereafter be leased by the railway company to electrical companies for the accommodation of their wires, would yield to that corporation a sum of perhaps $900,000 a year, which sum should properly go into the city treasury. The application for a mandamus will be argued before Justice Pryor a week from to-day. If it be granted, General Collis will be directed by the court to abate the public nuisances which, it is alleged, are being created by reason of the work of construction of the conduits complained of, by stopping the alleged illegal acts on the part of the Metropolitan company, and also compelling the removal of the conduits already laid. At any rate, it is urged, the company, even if it is not compelled to remove the conduits, must go on record as declaring that they will be used only for the operation of its own lines of railway.

At Trenton, N. J., yesterday, the certificate of incorporation of the Sprague Electric company was filed with the secretary of state. The corporators are Albert B. Chandler, Edward E. Johnson and Frank J. Sprague. The principal office of the company will be at Watsessing, N. J., where the business will be conducted. The company receives power, however, to conduct its business in other states and in foreign countries, and to hold real and personal property out of the state. The capital stock is $5,000,000, equally divided into common and preferred stock. The dividends of the company are to be paid at the rate of six per cent. on the preferred stock. The term of the corporation is 50 years. Its object is the manufacture of electrical appliances. William W. Cook, counsel for the company, says that the new company will take over the Sprague method of using electricity on elevated roads, and in the suburban and local business of steam roads, including the contract already obtained for equipping the South Side Elevated

Railroad company in Chicago. The company will also take over the property of the Sprague Electric Elevator company and its plant at Watsessing, which cost over $500,000. This will include the contract for the elevators for the underground road in London. Albert B. Chandler will be president and managing director of the company. It is said that J. Pierpont Morgan and John W. Mackay will be the largest stockholders. M. S.

PERSONAL.

Geo. B. Fraley, general manager of the Globe Electric Heating company of Philadelphia, is in Chicago.

Robert W. Hunt of the Robert W. Hunt & Co. Inspection Bureau, Chicago, sailed for Europe on October 2d, expecting to spend some considerable time abroad.

Thomas W. Fowler, for many years superintendent of the Lewis & Fowler Car company, died on September 30th at his residence in Brooklyn, at the age of 77 years.

Frank S. De Ronde of the Standard Paint company of New York has been visiting Chicago, en route to the meeting of railway superintendents of bridges and buildings at Denver, Colo.

Tom Johnson, who is conducting Henry George's campaign for mayor of Greater New York, is a resident of Cleveland and is largely interested in street railway properties of that city, Detroit and Brooklyn.

W. J. McConnell has been appointed the western representative of the Electrical Engineer of New York. Mr. McConnell is a man of many friends and he will doubtless find a welcome in the West. His office will be in Chicago.

H. Hilley has been appointed one of the electrical inspectors of the city of Chicago. Mr. Hilley's long connection with the electrical business eminently fits him to fill the position of inspector. His many friends are congratulating him.

I. R. Prentiss of Schenectady, N. Y., who has beeen connected with the Brush interests for years, and who was in charge of the Brush company's exhibit at the World's Fair, was in Chicago for a flying visit on Monday and Tuesday.

James F. Cummings of Pittsburg, known far and near among the electrical fraternity for his eminent success with Armorite and equally esteemed for engaging social qualities, spent a few days in Chicage early in the week. He has many Chicago friends, and they were all glad to see him.

Lord Kelvin and Lady Kelvin were the guests of President Francis L. Patton of Princeton at Prospect on Monday. They met the Princeton faculty in the Chancellor Green Library, after which they visited the points of interest on the campus. The degree of LL. D. was conferred on Lord Kelvin in absentia at the sesqui-centennial celebration at Princeton last year.

On Thursday evening of last week the Union Depot in Chicago was the scene of quite a gathering of electrical men; the occasion was the departure for a permanent residence in Philadelphia of C. W. Woodward, who has been for several years the manager of the western office of the Electric Storage Battery company of Philadelphia. Mr. Woodward came to Chicago a total stranger, but he not only made a great many warm personal friends, but his energetic and progressive business methods have left him an enviable record. Mr. Woodward, it will be remembered, was the active man in the matter of bringing about and pushing the negotiations between his home company and the men that had projected the Englewood and Chicago electric railway, which stands to-day a monument of a successful storage battery road. Mr. Woodward goes to Philadelphia to act as assistant to General Manager Lloyd of the Electric Storage Battery company, and his extensive western experience and knowledge gained of western methods will undoubtedly make his services in his new capacity of decided value.

ELECTRIC RAILWAYS.

The trains of the Metropolitan West Side company are now running over the Union Loop in Chicago. The Alley "L" trains will be run over the loop early next week.

The New Rochelle Electric Railway company was incorporated by the secretary of state at Albany, October 7th, to construct a road eight miles long. The capital stock is placed at $80,000 and the directors are William T. Emmet, Charles Nutt, Samuel F. Swinburne of New Rochelle.

The Cicero (Ill.) Town Board is making another effort to secure a five-cent fare into Chicago. Negotiations have been opened between President Traill and representatives of the Yerkes corporations, and although no definite agreement has been arrived at the lower rate is said to be within the bounds of possibility. The Lake street 'L" company is willing to construct a surface extension from the elevated to Oak Park and to charge only five cents into the city, provided the franchises of the Cicero and Proviso and Ogden street railways shall be extended 50 years.

The principal enterprise now on foot in the Department of Transportation of Hanover is the extension of the network of electric lines to Hildesheim, 14 miles distant, for the purposes of both passenger and freight traffic. It is not at all unreasonable to suppose that American firms interested in this class of work might find that they have at their disposal various devices which the Germans would be glad to adopt. "Frequent disasters on railroads in Germany are the means of directing attention to appliances for the prevention of such accidents," says a recent writer, "and this again is an opportunity that our manufacturers should not overlook. But in order to take advantage of such hints and opportunities those interested must be ably represented by agents competent to see what is needed and present to push every opportunity."

TECHNICAL SCHOOLS.

The formal dedication of the Bradley Polytechnic Institute at Peoria took place on October 8th in the auditorium of Bradley Hall, the main building. Lyman J. Gage, the secretary of the treasury, made the principal address. The institute will be affiliated with the University of Chicago.

ELECTRICAL SECURITIES.

The Detroit, Lake Shore and Mt. Clemens Railway company has executed a $260,000 mortgage to the New York Security and Trust company of New York city, which has been filed in the register of deeds' office.

Metropolitan Street Railway company stock, issued in exchange for Metropolitan Traction company stock, amounting to $6,000,000 thus far exchanged, has been admitted to the unlisted department of the New York Stock Exchange.

It is stated that the Fidelity Trust company of Louisville has completed the deal for a sale to the Cincinnati Street Railway company of nearly all the second-mortgage bonds of the Cincinnati Incline Plane Railway company, known as the Main street line. Negotiations have been pending for a long time for the transfer of this road.

It is stated that prominent interests in the Electric Storage Battery company are in favor of retiring the outstanding scrip promptly, and it will probably be paid off before the close of the year. It amounts to but $40,000, and as the company earned a surplus of $135,000 last year and will earn between $200,000 and $300,000 this year, the scrip can easily be taken out of the earnings.

The Bridgeport Traction company reports gross earnings for September of $28,507, an increase of $89 as compared with the same month of last year, and net $15,416, an increase of $4,748. For the three months ended September 30th the gross earnings were $92,882, a decrease of $5,863 as compared with the corresponding period of last year, and net $49,709, an increase of $4,734.

The reorganization committee of the Missouri Edison company is making good progress with its work. The capital stock of the new company will be $4,000,000, and it will be bonded up to the limit under the state law. The first-mortgage bondholders will be given additional security by having their mortgage cover the entire property of the reorganized company. Arrangements are now being made to float the new issue of $4,000,000 bonds in New York city. The stockholders of the old company, who would have been "wiped out" except for the arrangement made by the reorganization committee to take care of them, will be given 50 per cent. of their holdings in stock of the new company, while the second-mortgage bondholders will receive 50 per cent. of their holding in preferred stock of the new company.

MISCELLANEOUS.

The Wuozen Electrical company is the title of a company which has just been formed in St. Petersburg with a capital of 3,500,000 roubles, to acquire the right to certain water power on the river Wuozen, in Finland, and to install a plant to utilize this power in the generation of electrical energy for lighting and power purposes. It is reported that Brown, Boveri & Co. of Baden, Switzerland, are interested in the project.

American Trade is the title of a small paper which is published by the National Association of Manufacturers at No. 1751 North Fourth street, Philadelphia, Pa. The first issue bears the date of October 1st, and it is announced that it will appear on the 1st and 15th of each month. The purposes of the paper are to advance the welfare of the industries of the United States, and particularly to assist in procuring the broader opening of foreign markets for American products.

A man in Duluth has invented a device for indicating the presence or absence at office of the person sought. The device is designed to enable callers having business with tenants to tell by a glance at the building directory whether the person desired is in his office or not. It takes the place of the usual building directory, giving the name and number of the office of each tenant. When one leaves his office for any length of time he can touch an electric button and his absence and the hour at which he will probably return will be indicated on the board at the entrance to the building. When he returns and seats himself at his desk he again touches the button and the board shows that he is again ready to receive callers. If it is not desirable to have an electrical attachment, the information desired can be given by the office tenant as he enters or leaves the building, and the indicator on the directory board moved by hand. It is to be feared, however, that busy men would not be always careful to signal their return to office on the indicator.

TRADE NEWS.

The Ball Engine company of Erie, Pa., is doing a good business and branching out by building larger sizes of engines.

The new Chicago supply house, the Reliable Electrical Supply company, reports that it has been very busy of late and that the business as well as the method of prompt delivery are getting to be known. The company will soon bring some specialties before the public.

The Davis & Egan Machine Tool company of Cincinnati, Ohio, has sold through its Berlin office a large line of lathes, shapers, drill presses, etc., to the A. Borsig company of Germany, which operates one of the largest locomotive works in Europe, employing over 8,000 men.

George R. Hamlin, with office at 606 F street, Washington, D. C., is a gentlemen who has had long experience in the procuring of patents, and who has been very successful in this pursuit. Mr. Hamlin has recently created a special department for electrical business. He will give to this department his personal supervision.

The Leecol Storage Battery company of Chicago has brought out a portable storage battery lamp with ruby-colored glass front designed for use in photographers' dark rooms. The idea is an excellent one, and will doubtless redound to the profit of the manufacturers. The lamp will burn from eight to 10 hours with one charging.

K. McLennan & Co., sole manufacturers of the celebrated Gale's commutator compound, state that they will have at the street railway convention a supply of cards on which all persons who are troubled with sparking and cutting of commutators may write their names and addresses and secure free a sample stick of the compound. To those who do not attend the convention these sample sticks will be sent free upon application to the office at 1128 Marquette building, Chicago.

A Racine (Wis.) dispatch states that a deal has just been consummated transferring the big plant of the J. I. Case Threshing Machine company to a syndicate of eastern capitalists. The purchase price is said to be $2,000,000. It is said that for a long time there has been considerable discord among the stockholders and some changes have recently been made in the management. Stockholders held their interest at $4,000,000, but accepted the proposition, knowing that something had to be done.

The indications, from the orders which have been placed with the Electric Arc Light company, maker of the Pioneer inclosed arc lamps, are that there is a special movement among dry goods people in anticipation of the conceded revival in trade. Among this company's New York orders, it reports just having closed with the dry goods firm of H. O'Neil & Co., Sixth avenue and Twentieth street, for the equipment of their establishment with Pioneer lamps. The Pioneer people state that this order was obtained as a result of a test where their claims were fully established for the highest efficiency, the lowest consumption of current and steadiness; also demonstrating the superiority of their type of mechanism as against the direct-carbon feed lamps.

Eugene Munsell & Co., miners and importers of mica, New York and Chicago, will exhibit their line of India and amber mica at the street railway convention to be held at Niagara Falls from the 19th to the 22d of this month. Franklin Brooks of the New York house and Chas. E. Coleman, manager of the Chicago branch, will be in attendance. The exhibit will be in connection with that of the Mica Insulator company, occupying space No. 11, and will consist of mica in the sheet as it comes from the mines, mica segments and a variety of cut sizes as used by the electrical trade generally. A souvenir in the form of a puzzle will be given to those who call at the booth. This little novelty is known as the mica mine puzzle. The idea is to get all the miners into one mine. The delegates in attendance will find this a difficult matter to do, and it will provide innocent amusement during the quiet hours after the banquet.

The Monona Cedar company of Marinette, Wis., has just entered the field for the sale of white cedar products. The company was incorporated with a capital stock of $500,000 and has started four yards at advantageous railroad points. The officers of the company are T. E. Brittingham of Madison, Wis., president; J. M. Hixon of La Crosse, Wis., vice-president, and J. E. Reinger of Ingalls, Mich., secretary and treasurer. The Monona company makes a specialty of white cedar poles for telephone, telegraph, electric light, street railway and other purposes and claims to be able to furnish the best stock. It is already meeting with excellent results, having secured a number of good orders from some of the prominent telephone and electric light com-

panies in the West. The company is said to be in a position to quote attractive prices, and it is suggested that those in the market for white cedar products write to the Monona company before placing their orders.

The General Electric company will make a representative exhibit at the sixteenth convention of the American Street Railway association. The space selected by it is immediately to the right of the entrance on Walnut street, and the exhibit will occupy 1,100 square feet. The headquarters of the company will be at the International Hotel, where its interests will be cared for by the following-named representatives: Railway department, W. J. Clark, general manager; W. B. Potter, chief engineer; R. H. Beach, L. D. Tandy; supply department, J. R. Lovejoy, general manager; H. C. Wirt, chief engineer; J. H. Aitken; meter department, C. D. Haskins; convention committee, F. M. Kimball, secretary, Boston; T. Beran, New York; A. D. Page, manager incandescent lamp department, Harrison, N. J. The sales offices will be represented as follows: New York, W. G. Bushnell, A. B. Shepard; Chicago, T. P. Bailey; Philadelphia, F. C. Mullen, H. J. Crowley; Boston, C. C. Peirce; Cincinnati, W. F. Hays, F. H. Strieby or H. H. Corson; Atlanta, S. W. Trawick; San Francisco, F. F. Barbour.

The strong rivalry between the American Bell Telephone company and the Citizens' Mutual Telephone company of Decatur, Ill., which has been noticeable for many months, has at last resulted in victory for the home company. It appears that the Bell company has had on the ground three expert solicitors for several weeks, and enough new subscribers to its exchange system were secured by these men to warrant, in the opinion of the management, the increase of telephone rates, as it was assumed that with these additions the Bell service would be much more valuable than the service given by the home company. The Bell company raised the rates on the first of the present month from $18 for residence telephones and $24 for business telephones to $24 and $36 respectively, and subscribers refused to pay these rates. Two hundred of the Bell subscribers signed contracts with the Citizens' company at the regular rates, which are $1 per month for residence telephones and $2 per month for business telephones. The Bell company had approximately 500 telephones in use and the Citizens' company about the same number. The Citizens' company is now increasing the capacity of the plant and will add upward of 200 new stations and will have connected within the next 60 days over 700 subscribers. The old company has fallen off from 500 to less than 300. The American Electric Telephone company of Chicago has been awarded the contract to furnish additional equipment, consisting of telephones, switchboards and appliances, to meet the demands of the increase. A large amount of new construction work will be done, and John A. Roebling's Sons company has been awarded the contract to furnish cable.

BUSINESS.

W. W. McChesney, Jr., representing Huebel & Manger of Brooklyn, spent a week in Chicago on his regular western trip. Mr. McChesney reports a steady increase in his line of business.

Everyone desires to keep informed on Yukon, the Klondyke and Alaskan gold fields. Send 10 cents for large compendium of vast information and big color map to Hamilton Publishing company, Indianapolis, Ind.

The catalogue of the products of the Perkins Electric Switch Manufacturing company of Hartford, Conn., is an attractive one and shows only such goods as are made by the company under its own patents. The switches, sockets, rosettes, cut-outs and lamps supplied by the Perkins company are well known and need no comment. Edward K. Patton represents the company in Chicago, with an office at 1537 Monadnock building.

F. N. Manross of Forestville, Conn., manufactures hair-springs for all purposes. He claims, on an advertising blotter recently issued, to be the largest manufacturer of hair-springs in the United States.

Telephones, telephone supplies and electrical house goods are made and dealt in by De Veau & Co. of 32 and 34 Frankfort street, New York, who have recently issued a new edition of their convenient catalogue.

J. H. Cook, the western representative of the Jandus Electric company, manufacturer of the Jandus (formerly known as the Manhattan) enclosed arc lamp, reports a promising outlook for business the coming season.

Schiff, Jordan & Co. of 232-234 Greenwich street, New York, report that they have put in double stock of their carbons since September 15th in order to meet the large increase in orders for their goods. They have increased the output of the factory in Vienna to such an extent that they have added materially to this department, and the same may be said of the factory located at Nuremberg. Especial attention has been given to the demand for carbons to burn in 150-hour arc lamps. The firm has also the usual full stock of plain and coppered carbons.

The Mica Insulator company of New York, Chicago and London will exhibit at the street railway convention at Niagara Falls next week a full line of its "Micanite" insulating specialties. During the last year the company has added several new lines of insulating materials to its already extensive list. Two of these may be mentioned—the flexible "Micanite" plate and "M. I. C." insulating compound. "Micanite" and "Empire" cloths and papers, together with "Micanite" plates for commutator segments, will be attractively displayed, and as the company is a manufacturer of commutator rings and segments to a large extent, the exhibit promises to be one of unusual interest to all railway men in attendance. Franklin Brooks, vice-president of the company, and Chas. E. Coleman, manager of the Chicago branch, will be in attendance and be pleased to welcome their many friends in the trade.

J. H. Rhotehamel, president of the Columbia Incandescent Lamp company of St. Louis, is without doubt one of the best informed lamp manufacturers in the United States. Concerning the new Maxim lamp Mr. Rhotehamel says: "The statement in the press dispatch in regard to the economy of American lamps is in error. The best quality of American lamps average between 3.1 and 3.5 watts to the candle. It is stated in the dispatch that the American lamps run 4.8 to 5 watts to the candle. It is also stated that European lamps take 4.2 watts to the candle. The lamp of Mr. Maxim is reported to be a 40 candle power lamp (voltage not stated), and taking 2.8 watts to the candle. In high-candle power lamps one can readily get higher economy than when one makes lamps at 8, 10 and 16 candle power, and an 8, 10 or 16 candle power lamp at 3.1 watts is, in fact, a showing of higher economy than 40 candle power of 2.8 watt lamps, considering the relative amount of light furnished. When one attempts to get high economy in very low candle power one cannot succeed so well as if dealing with very high candle power. The type of lamp manufactured in the United States for several years, and, in fact, until about three years ago, was of a type such that while starting at a high economy, the filaments increased in resistance to such an extent that the light fell off so much that they soon became lamps of low economy. The lamps manufactured by the writer's company during the past three years possessed the following qualities: The resistance of the filaments from the beginning of its time of burning throughout the entire life of the lamp is almost absolutely maintained. This result brings naturally with it a maintenance of candle power. If the filaments increase in resistance it follows that the light also must decrease. We believe the present filament manufactured by us is superior to any yet attempted and that Maxim's filament, with all that is claimed for it, is not its equal. I think that the American manufacturer should be treated fairly in this matter and should not be misled by statements in regard to Maxim's lamp that are not correct. Consideration should be given to the quality of the American product in comparison to what Maxim claims. The result of this comparison would show that Maxim has, on the claims made, made no improvement over the American product, assuming that the statement of his correspondent is correct in regard to the quality of the lamp which he claims to have produced."

The Clonbrock Steam Boiler company, Brooklyn, N. Y., reports recent sales of Morrin Climax boilers as follows: Salt Lake County Light, Heat, Power and Cold Storage company, Salt Lake City, Utah, four 250 horse power boilers; Queen Dyeing company, Providence, R. I., one 400 horse power boiler; United Electric Light and Power company, New York city, three 600 horse power boilers; Providence Gas company, Providence, R. I., one 250 horse power boiler (second order); Converse Building, Boston, Mass., two 125 horse power boilers; Roxbury Gas company, Roxbury, Mass., two 50 horse power boilers; Economy Light, Heat and Power company, Scranton, Pa., two 300 horse power boilers; People's Light and Power company, Jersey City, N. J., one 600 horse power boiler (fourth order); Whitney Factory, North Attleborough, Mass., one 80 horse power boiler; Brazer building, Boston, Mass., two 90 horse power boilers; New Jersey and Pennsylvania Concentrating Works, Edison, N. J., two 350 horse power boilers (third order); Riverside Iron Works, Wheeling, W. Va., two 550 horse power boilers (twelfth order); Tennessee Centennial Exposition company, Nashville, Tenn., 2,500 horse power; Providence Gas company, Providence, R. I., one 200 horse power boiler; Crescent Insulated Wire and Cable company, Trenton N. J., one 200 horse power boiler; Jacksonville Electric Light company, Jacksonville, Fla., one 200 horse power boiler; Jersey City, Hoboken and Rutherford Electric Railway company, Rutherford, N. J., one 350 horse power boiler (second order); Geo. Watkinson & Co., rubber works, Philadelphia, Pa., one 300 horse power boiler (second order); People's Light and Power company, Orange, N. J., two 600 horse power boilers; New York Steam company, East Sixtieth street, New York city, two 1,000 horse power boilers; Hazleton Manufacturing company, Hazleton, Pa., two 200 horse power boilers; American Manufacturing company, Brooklyn, N. Y., one 500 horse power boiler (second order); Mathieson Alkali Works, Saltville, Va., one 500 horse power boiler (second order); Latimer & Fernandez, St. John, Porto Rico, one 250 horse power boiler; Edison Electric Light company, York, Pa., one 350 horse power boiler. In addition to the above, the Clonbrock shop is working on many orders for prompt delivery and most of the sales have been made to old customers who are enlarging their plants. The company is highly pleased with its past sales, and indications now point to a very busy season. The company has also secured the entire power plant required by the Trans-Mississippi and International Exposition company, Omaha, Neb., which is another triumph for the Climax boiler.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued October 5, 1897.

591,002. Electric Bell-chiming Apparatus. Neal McMenamin, Trenton, N. J. Application filed November 18, 1896.

Means are provided for ringing bells and for other purposes, comprising essentially a circuit closer, an operating lever or key for tilting the circuit closer to complete the circuit, and means to restore the circuit closer to its normally inactive position when released from the influence of the lever or key, combined with a bell-actuating lever adapted to be connected with the bell, a pole-piece suspended from the bell-actuating lever, an electro-magnet arranged adjacent to the pole-piece, and electric conductors wired with the electro magnet, the circuit closer being arranged and operated to make and break the circuit between the conductors.

591,010. Automatic Test Circuit. Lewis G. Rowand, Camden, N. J. Application filed December 22, 1896.

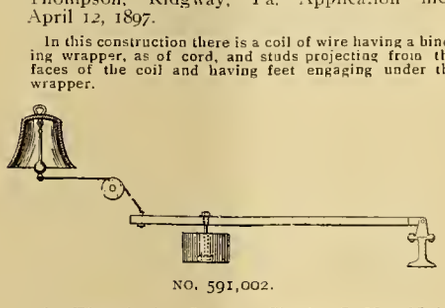
A main circuit and a secondary circuit are provided, the latter having a source of current supply independent of the main circuit supply, and separate branches with indicating devices and a switch in each branch, the switch of one branch being provided with a device tending to keep it closed, and the switch of the other branch with a device tending to keep it open, an electro-magnet acting when energized against both the devices.

591,011. Telephone System. Allen W. Rose, New York, N. Y. Application filed October 7, 1896.

A telephone exchange operator's table is described, consisting of a frame, a series of strips mounted upon the frame and independent of each other, call-off, listening and ringing keys supported by each of the strips and connections for the keys, whereby each of the strips with the keys carried by it may be removed independently of the other strips.

591,024. Dynamo-electric Machine. Milton E. Thompson, Ridgway, Pa. Application filed April 12, 1897.

In this construction there is a coil of wire having a binding wrapper, as of cord, and studs projecting from the faces of the coil and having feet engaging under the wrapper.



NO. 591,002.

591,026. Electric Arc Lamp. Charles S. Van Nuis, New Brunswick, N. J. Application filed May 1, 1896.

An inclosing globe and a cap through which one of the carbons passes are claimed, the cap consisting of several circular cup-shaped parts screwed together to form separate chambers having central openings in the walls thereof for the carbon and valves for each chamber.

591,042. Trolley for Electric Cars. William L. Harvie, Newton, Mass. Application filed October 2, 1896.

The fork is mounted in the trolley wheel with plates upon each side and hinged at their upper ends to the upper ends of the fork; cords are connected to the lower ends of the plates, and grips rotarably mounted on the plates and extended beyond the upper ends thereof, while springs are arranged between the outer faces of the fork and the inner faces of the plates.

591,071. Electric Gas-lighting Apparatus. Adrian L. Bogart, Jamaica, N. Y. Application filed February 24, 1897.

The electrical valve controller is adapted to maintain the valve open while the circuit is closed at the circuit controller or key, and to close the valve when the circuit is open at the circuit controller or key.

591,081. Method of Magnetizing. William D. Marks, Philadelphia, Pa. Application filed August 3, 1897.

The method is described of tempering and magnetizing steel, consisting in first heating the steel to a sufficient degree, then simultaneously subjecting the heated steel to the influence of a magnet and immersing the heated steel in a tempering bath.

591,100. Electric Railway. John C. Henry, Denver, Colo. Application filed June 29, 1897.

Electric motors are connected to the generating plant and have their field magnets excited by a current independent of the armature currents, the controlling devices connecting the armatures of the motors in series or parallel relation.

591,104. Insulator for Electric Wires. Willis Roberts, Mobile, Ala. Application filed November 3, 1896.

A wire-attaching and insulating device is provided with a transverse opening, a slot to admit the wire into the opening, and a groove intersecting the slot and adapted to receive and retain the wire.

591,105. Electro-magnetic Braiding Machine. Alpheus C. Shuttleworth, Philadelphia, Pa. Application filed March 2, 1896.

Electro-magnets are placed in proximity to the shuttles on either side thereof; contact plates are carried by the revoluble shuttle-carrying shells; brushes are carried by the frame which complete the circuit with the magnets through the contact plates, and a source of electrical energy for exciting the magnets.

591,123. Igniting Means for Explosive Engines. Vincent G. Apple, Miamisburg, Ohio. Application filed April 22, 1897.

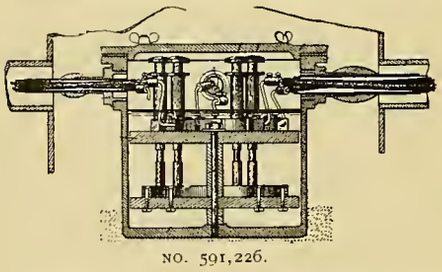
A dynamo driven by an engine is in circuit with the contact points, with which a battery is also in circuit; there is also an electric alarm with a switch and connections adapted to cause the battery to furnish current for the first few explosions until the engine is driving the dynamo at normal speed, when the dynamo develops current to sound the alarm, which ceases only when the switch is moved to bring only the dynamo in circuit with the contact points.

591,127. Telephone Exchange System. William R. Cole, Detroit, Mich. Application filed April 28, 1897.

The first claim follows: The combination with the main lines and terminal contacts therefor arranged in groups of trunk lines equal in number to the total number of main lines, and extending to all the groups, main and auxiliary annunciators for each of said main lines and their corresponding trunk lines arranged at their respective main-line groups, said main annunciators adapted in their operation to operate their auxiliary annunciators, and said auxiliary annunciators adapted when operated to break their operating electric circuits; means at each group for closing an electric circuit through any one of the trunk lines and its auxiliary annunciator when the latter is in its normal position, a signal for indicating to the operator when said circuit is closed, and means for connecting any of the main-line contacts of each group with any of the trunk-line contacts.

591,141. Process of and Apparatus for Electrolytic Extraction of Metals from their Solutions. Joseph W. Richards, Bethlehem, Pa. Application filed March 6, 1897.

The process of extracting metals from their solutions consists in subjecting such solutions to the electrolytic action of an electric current passing into the solution by a liquid amalgam anode, and separating the anode from its cathode by a porous partition.



NO. 591,226.

591,160. Electric Apparatus for Surgical Purposes. Willard E. Dow, Braintree, Mass. Application filed August 16, 1897.

A rotatable cylindrical body of insulating material has a longitudinal bore with resistance wire wound on the body in the form of a helix with separated coils, a contact piece in constant electrical engagement with the helix, a rod entering the bore of the cylinder, and means intermediate the rod and cylinder acting upon rotation of the latter to cause axial movement thereof.

591,162. Speed and Direction Indicator. Bradley A. Fiske, U. S. Navy. Application filed February 24, 1896.

The indicator is situated in a casing mounted in gimbals and a rheostat mounted upon the standard supporting the gimbals, with flexible conductors connecting the rheostat and the indicator, whereby the rheostat may be adjusted without interfering with the freedom of movement of the indicator.

591,182. Electric Arc Lamp. Ernest P. Warner and August J. Oehring, Chicago, Ill. Application filed August 10, 1896.

A vertically adjustable carbon carrier is suspended from one end of a ribbon; a weight is suspended from the other end of the ribbon; an electrically operated clutch mechanism engages the ribbon, controls its feeding movement and secures the adjustment of the same, and means are controlled by the movement of the ribbon for altering the circuits through the lamp.

591,192. Multiple Switchboard for Telephone Exchanges. Walter S. Nash, Knoxville, Tenn. Application filed May 20, 1897.

A test-thimble is attached to each of the spring-jacks, one end of each spring switch being in electrical engagement with the test-thimble of a corresponding spring-jack, and adapted to be operated by the insertion of a suitable switch-plug through the thimble of the spring-jack.

591,194. Method of and Apparatus for Multiple Rate-metering for Electric Currents. Eustace Oxley, Washington, D. C. Application filed August 23, 1897.

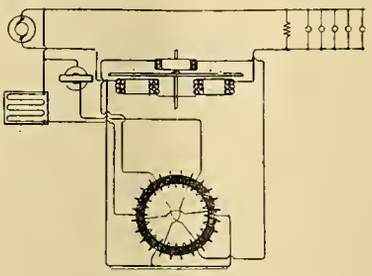
The method described of metering the consumption of electric energy at different rates during different periods of time consists in inserting a definite resistance in the armature circuit of each one of a number of meters installed at a corresponding number of separate points of consumption, maintaining the resistances in the circuits during the period of consumption at a reduced charge, and withdrawing the resistances during the period of consumption at full rate.

591,195. Method of and Apparatus for Multiple Rate-metering for Electric Currents. Eustace Oxley, Washington, D. C. Application filed August 23, 1897.

This method consists in varying the speed of the registering mechanism at a number of consumers' stations by connecting the armatures of the meters between the two outside wires of a three-wire system for one period and rate, and between the neutral and one of the outside wires for the other period and rate.

591,201. Electrical Exchange. Almon B. Strowger, Frank A. Lundquist, John Erickson and Charles J. Erickson, Chicago, Ill. Application filed July 17, 1895.

Claim is made for the combination with a series of wires or contacts of a series of rods or parts, each insulated from the other, and each carrying angularly displaced contact arms or wipers, means for rotating the rods step by step to bring the arms thereof into engagement with the wires, and a selector for connecting a line wire with either of the rods.



NO. 591,240.

591,203. Commutator for Dynamo-electric Machines. James J. Wood, Fort Wayne, Ind. Application filed April 29, 1897.

Features of this invention are the spider and segments, the latter having substantially parallel clamping portions at opposite ends and two segmental clamping rings overhanging the opposite clamping ends of the segments, and radial screws or bolts for drawing the segmental clamping rings against the segment ends.

591,217. Electric Clock. Carl Gullberg, Jersey City, N. J. Application filed February 25, 1897.

The switch point has rubbing contact with the spring and also with its pivot, which is connected with one of the circuit wires, the contact spring being in connection with the other circuit wire.

591,226. Junction Box. Jacob Cloos, Milwaukee, Wis. Application filed March 6, 1897.

Bus-bars or conductors are located in the junction boxes, feeders and mains connected with the bus bars, auxiliary feeders extending between the junction boxes, and switching mechanism for uniting the auxiliary feeder with the bus-bars.

591,240. Phase Adjusting Method and Means for Alternating Current Apparatus. Oliver B. Shallenberger, Rochester, Pa. Application filed January 9, 1897.

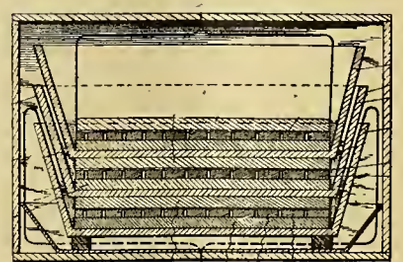
The field coil is supplied with an alternating current, and a second field coil and a transformer having a secondary circuit including the second field coil and inductively influenced by two primary circuits is connected to the source supplying the first field coil by circuits having different co-efficients of self-induction.

591,241. Electrical Measuring Instrument. Oliver B. Shallenberger, Rochester, Pa. Application filed January 26, 1897.

An electrical measuring instrument comprising a permanent magnet having polar extensions and a magnetic shield partially surrounding the extensions for equalizing the distribution of the magnetic field, and means for adjusting the shield with reference to the polar extensions.

591,242. Alternating Current Electric Motor. Oliver B. Shallenberger, Rochester, Pa. Application filed June 7, 1888.

The conversion of electrical energy of alternating currents into mechanical energy in an electric motor is effected by establishing a system of alternating lines of force, causing a portion of such lines of force to directly induce secondary alternating currents, the direction of whose path is at an angle to the first-named currents, establishing by such secondary currents lines of force at an angle with reference to the polar line of the first-named currents, and causing the movable element of the motor to move under the influence of the resultant effects of the two systems of lines of polarization thus produced.



NO. 591,265.

591,251. Trolley Finder for Electrical Railroads. Paul Goldsmith, Troy, N. Y. Application filed February 10, 1897.

Two outwardly flaring arms are arranged to approach each other; the trolley wheel is in close proximity to the rim of the latter at its top; each arm is journaled onto the trolley wheel shaft where projecting beyond the wheel; a frame part at each of its two upper ends is hinged to the lower end of one of the trolley finder arms and constructed to lock and be reversed on the hinged connection with the frame.

591,265. High-tension Battery. Ralph Ashley, Port Republic, N. J. Application filed November 27, 1895. Renewed March 25, 1897.

A secondary battery comprising the non-conducting cups or trays is nested together, but out of contact with each other, forming a vertical stack or pile, the positive and negative electrodes secured to the inner and outer sides of the bottom of the cups, the conductors connected with the negative electrodes of each cup passing up over the edge of the cups and then down to and connected with the positive electrode.

591,267. Alternating Current Generator. Charles S. Bradley, Avon, N. Y. Application filed June 22, 1896.

The method of varying the rate of an alternating current generator consisting in developing a rotary magnetic field in one winding and varying the rate of rotation of the field.

591,268. Alternating Current Motor. Charles S. Bradley, Avon, N. Y. Application filed June 22, 1896.

An alternating current induction motor having a stationary element provided with a rotary field winding, a rotary element connected with a primary coil wound on an annular core fixed to the rotary element, a secondary coil on a core in close inductive relation to the primary coil, and a regulating switch in circuit with the secondary coil.

591,301. Alternating Current Electric Motor. William Stanley, Jr., Great Barrington, Mass. Application filed October 23, 1888.

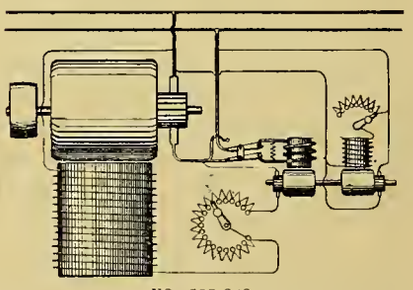
An electric motor is described, consisting of a field magnet having a closed core and having two coils, one adapted to be connected in series with a source of alternating electric currents, and the other acting as a secondary coil with reference to the first, whereby the effects of the current induced in the latter and the current flowing in the former combine to establish poles in the field magnet core and an armature in the field of force thus established.

591,331. Electric Switch. William A. Drewett, Brooklyn, N. Y. Application filed March 15, 1897.

A switch comprising a base provided with stationary contacts, a contact arm, a spring adapted to hold the arm in its normal open position, a handle and connections between the handle and arm to move the arm in either direction to close the circuit and to release the arm and permit it to assume its normal position under the influence of the spring to break the circuit.

591,339. Railway Telegraph. Albert C. Frieseke, Floral Bluff, Fla. Application filed November 20, 1895.

In a railway telegraph or telephone system, a main station and sub-stations carried by trains, three wires connecting the stations, a set of instruments in each station, the instruments of the main station being connected to the first and second wire, the instruments of the sub-stations being connected in multiple to the second and third wires, a switch at the main station to throw the instruments of that station in connection with the second and third wires, and switches in the sub-stations to throw their instruments in connection with the first and second wires.



NO. 591,343.

591,343. Indirect Regulation of Dynamo-electric Machinery. Gano S. Dunn, East Orange, N. J. Application filed July 8, 1896.

The method of regulating one dynamo-electric machine by another consists in making variations in the field strength of the regulating machine dependent upon the current in the armature of the machine to be regulated, and independent of the current in its own armature and making variations in the field strength of the machine to be regulated dependent upon the algebraic sum of the voltages of the line and the regulating machine.

591,344. Indirect Regulation of Dynamo-electric Machinery. Gano S. Dunn, East Orange, N. J. Application filed July 10, 1896.

The method of obtaining a constant current upon a main circuit consists in connecting the circuit to a constant potential source through the armature of a regulated machine, energizing the field magnet of the main regulated machine from a source which is controlled by the current in the main circuit, and varying and reversing the current supplied to the field coils of the regulated machine, whereby the current on the main circuit is kept constant.

591,345. Indirect Regulation of Dynamo-electric Machinery. Gano S. Dunn, East Orange, N. J. Application filed June 22, 1897.

The method of regulating electric motors consists in supplying the armature with a constant current, supplying the field from a source of energy separate from that which supplies the armature, and varying the field by varying the effective electromotive force in the field circuit simultaneously with the speed of the armature of the machine to be regulated.

591,365. Magneto-electric Generator. Joseph A. Williams, Cleveland, Ohio. Application filed May 3, 1897.

The pole-piece consists of a plate cut, stamped and formed with the lower edge slitted, folded upward, and with the outward bends forming seats for the permanent magnets.

591,369. Illuminated Electric Sign. George K. Burleigh, Northfield, N. H. Application filed October 31, 1896.

Included in this arrangement are the main circuit, a plurality of branch lamp circuits, circuit closers intermediate the main and branch circuits, a spring motor to operate the circuit closers, and a cut-out, one member of which is connected with the main circuit and the other member with the circuit closers, the yoke-like movable member of the cut-out being engaged and moved by the expansion of the motor spring to finally cut out the lamps,

Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, OCTOBER 23, 1897. No. 17

Albion E. Lang, President American Street Railway Association.

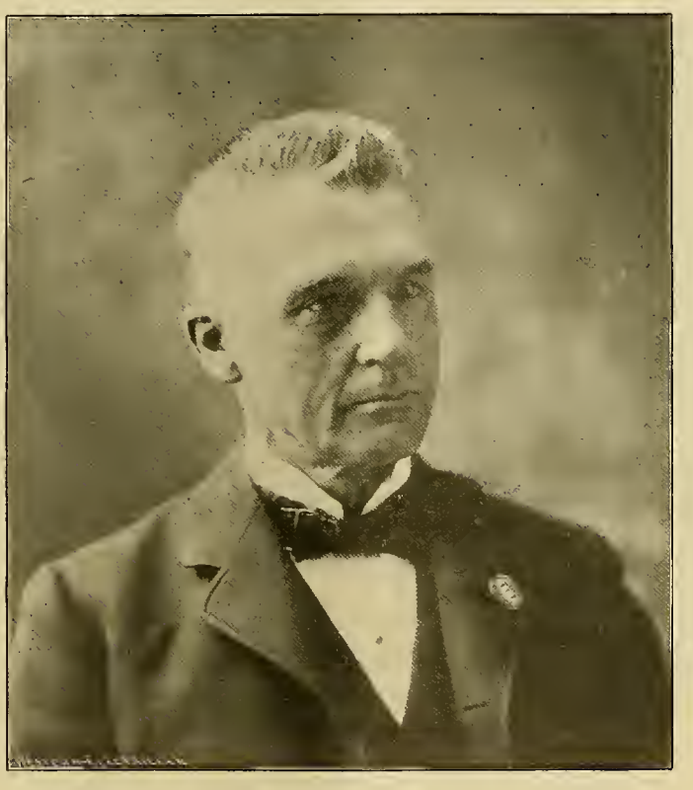
The newly elected president of the American Street Railway association dates his entrance in the street railway field back to the time when the organization of which he has just been elected president was formed, 16 years ago. Albion E. Lang secured control of a horse-car line in Toledo, Ohio, at that time. In 1885 he added another line; further acquisition was made four years later, and in 1896 the entire system of street railways of the city passed under the control of the Toledo Traction company, of which he is president. Mr. Lang is also president of the Toledo Consolidated Electric company, which furnishes light and power in that city. Both companies secure their current from one power house.

President Lang has seen the street railway business of Toledo develop from a few straggling horse-car lines to a network of 120 miles of electrically operated roads. Other changes of equal importance have been made during his administration. When he assumed charge of the horse-car line 16 years ago, the employes worked 16 hours a day. Since then their hours of service have been gradually decreased until now nine hours constitute a day's work. Their condition has been improved in other respects, and they are contented, happy and prosperous.

President Lang has been prominently identified with the American Street Railway association since 1887. He attended the meeting at Washington, which was a notable gathering, as it marked the first important step from the old horse-car service to the modern overhead trolley system. He recalls the fact that it was at that meeting that objection was raised to consideration of the electric system. Some of the old-timers wanted "practical subjects" discussed, such as the feeding and care of horses, the method of working them, etc. They protested against devoting valuable time to new-fangled ideas. President Lang has long been a member of the Ohio Tramway association, and served one term as president of that body.

The newly elected president is a native of Ohio. He was born at Huntington in 1849, and spent the early years of his life at Wellington. All his business interests are centered in his native state, but he is well and favorably known by street railway men throughout the country.

Mr. Lang will undoubtedly prove a worthy successor to the eminent street railway men who constitute the list of ex-presidents of the association. His long experience well fits him for the honorable position which his associates have called upon him to fill.



ALBION E. LANG.

Street Railway Investigation.

Mayor Harrison has named the street railway investigation committee previously noted in the Western Electrician. Alderman John M. Harlan will act as chairman of the committee. Mayor Harrison is chairman ex-officio, but he announced that his duties would not permit him to give the necessary time to the work cut out for the committee, and he designated Alderman Harlan to act in his stead. The other members of the committee are Alderman Jackson of the Fourth ward, Walker of the Twenty-fourth ward and Maypole of the Thirteenth ward. The committee will be called together in a few days and will then map out a plan of action. The council received the announcement of the committee in silence. The mayor's friends said he had named a committee that would carry out the instructions of the resolution under which it was appointed if any committee could do so. Mr. Harlan said that he believed that much information could be secured which would be of value when the extension franchises were under consideration, and the other members said they were ready to go to work at once.

J. and W. A. Elliott of Minneapolis secured the contract to furnish an electric light plant for Henderson, Minn.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the Western Electrician.]

The Wisconsin Valley Telephone company has arranged to extend its lines to Neillsville, Wis., soon. Mr. Heath of Mauston will put in a local exchange also.

J. L. Ball of Augusta, Wis., is furnishing a few telephones between offices and business places, and it is suggested that he put in an exchange.

The Northwestern Telephone Exchange company has decided to build a line this fall from Ramsey to Spring Valley, southern Minnesota.

A toll station on the new Northwestern telephone line has been opened at Wayzata, on Lake Minnetonka.

Telephone extension will be made this fall from Albert Lea to Northwood, Iowa, by the Bell Telephone people. The Iowa Telephone company will build from Mason City to Northwood to make connections with this line.

A local telephone exchange will be installed at Adrian, Minn.

A local telephone exchange has been established in Minneota, Minn., and connection has been made with Marshall, Tracy, Garvin, Balaton, Amiret and Ghent.

The Rushford Telephone company of Rushford, Minn., will extend a line to Winona, Minn., at once.

The Northwestern Telephone Exchange company will extend a line from Albert Lea, Minn., to Northwood, Ia.

The Portage Long-distance Telephone company has been granted a franchise for a local exchange at Lodi, Wis.

The Hanamo Telephone company of Marysville, Mo., has been granted a franchise for a local exchange at Clarinda, Ia.

Lars Erickson contemplates running a telephone line between Milaca, Minn., and the Bradbury Brook colony, in the spring.

The Blue Earth Valley Telephone company of Winnebago City, Minn., expects to have the local exchange in Mankato, Minn., in operation before snow falls. This company contemplates removing its headquarters to Mankato.

Mr. Heath of Mauston, Wis., has been granted a franchise for a local exchange at Neillsville, Wis.

The Wisconsin Valley Telephone company has arranged to connect with the Winona Telephone company at Winona, Minn., and will build to connect with Eau Claire, Ashland, Superior, Neillsville, Hudson and other Wisconsin towns, St. Paul, Minneapolis, Stillwater and other Minnesota towns.

J. L. Ball of Augusta, Wis., is furnishing telephones between offices and dwellings in that city and keeping them in repair, and it is suggested that he put in an exchange.

The Northwestern Telephone Exchange company will soon have connection between Willmar, Minn., and the Twin Cities.

The Dakota Central Telephone company of Aberdeen, S. D., contemplates extending its lines to Butler and Lilley.

The telephone war at Des Moines, Ia., between the Mutual and Iowa companies waxes furious. Merchants have threatened to boycott even the railroads if they do not use the Mutual instruments and have forced them to it. Rates have been cut in half. The Iowa company wants a new franchise and the council wants to impose burdensome conditions and refuses to grant any other. The American Telephone and Telegraph company has made application for a franchise, but the council suspected the franchise would immediately be assigned to the Iowa company, and so proposed to amend it to permit it to run wires only on certain streets, which would be all right for a long-distance system, such as it proposed, but would prevent a local exchange being operated under it. Action was finally deferred. It is also said that the Iowa Telephone company has approached the Mutual Telephone company with an offer to purchase that system, the amount being sufficient to cover all expenses and leave a neat margin. The offer is a standing one, and was refused.

The council of Green Bay, Wis., refused an extension of the franchise of the Northern Wisconsin Telephone company.

J. E. Keelyn has been finally granted a franchise for a telephone exchange in Chippewa Falls, Wis.

Electrical Progress on the Alley "L."

Five cars equipped with motors and controllers in accordance with the Sprague system are now on the Alley "L" structure on Sixty-third street. They are subjected to informal tests and seem to meet every requirement. The tracks are now bonded for electrical operation, and the third-rail is laid as far north as Twenty-seventh street. The drilling for the bonding was accomplished by two electrically operated drills. The motors were mounted on small trucks and connected with the drills by flexible shafts. Current was taken from the feeders of the Chicago City Railway company. Each drill could bore 200 holes in a working day through three-fourths inch web. The holes are seven-eighths inch in diameter. The foundations for the power house are about completed. The trains of the South Side company now run around the Union Loop, drawn by the steam locomotives. The loop service has brought a great increase in the number of passengers, said to have been 50 per cent. for the first day.

The Occident Club.

The Western Electric company of Chicago has provided two large rooms for the girls employed in its factory. These girls have formed a club called the Occident Club, which has now been in existence for two years. It is self-supporting and entirely managed by the girls themselves. The members have fitted up the rooms which have been furnished them by the company. One is a library and reading room and is also used for concerts. It has a seating capacity of about 500. The other is of the same size and has been fitted up with lunch counters and a kitchen. On Saturday of last week the Occident Club gave a literary and musical entertainment from 4:30 to 5:30 p. m., and from 5:30 to 6:30 furnished refreshments for those who cared to stay. The balance of the evening was spent in a social way. Over 400 persons attended the entertainment.

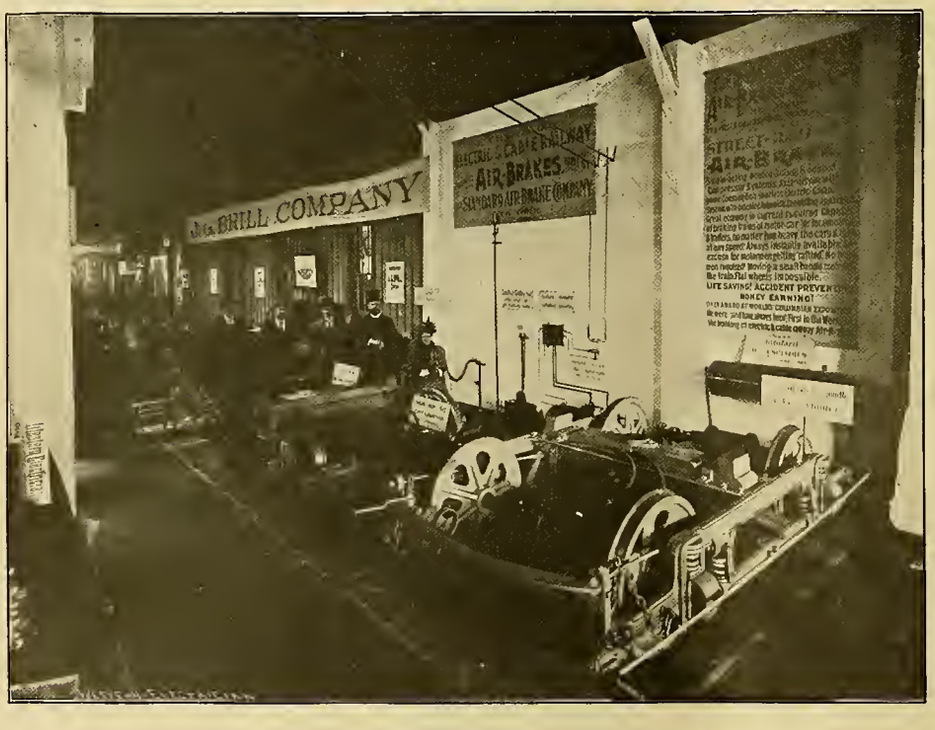
THE CONVENTION

Of the American Street Railway Association at Niagara Falls, N. Y.

Unusually favorable conditions attended the opening of the sixteenth annual meeting of the American Street Railway association at Niagara Falls, N. Y., this week. The weather was exceptionably mild for the season of the year, and as the large hotels had been practically deserted by the regular summer visitors, the street railway men had the town to themselves. Most of the exhibitors were on the ground Monday making arrangements for the display of their apparatus and the delegates began to arrive on Monday night, and at noon on Tuesday the visitors took formal possession of the city, Mayor Hastings having formally capitulated on behalf of the citizens.

It was estimated that the attendance, including delegates, manufacturers, supply men and other visitors, reached 1,000. The convention hall was packed during the opening meeting, and the big exhibition rooms downstairs were thronged all the time.

When the president, Robert McCulloch of St. Louis, called the meeting to order at 11 o'clock Tuesday morning, there were seated on the platform ex-Presidents H. H. Littell, Henry M. Watson, H. M. Littell and George B. Kerper and the following-named officers and members of the executive committee: Charles S. Sergeant, D. B. Dyer, C. F. Holmes, H. P. Bradford, Charles H. Smith and T. C. Penington.



STREET RAILWAY EXHIBITS AT NIAGARA FALLS.

The president introduced the Hon. A. C. Hastings, mayor of Niagara Falls, who made the following address of welcome:

"It hardly seems necessary for me, representing the city of Niagara Falls, to extend a welcome to an association of such a wide reputation that all cities are anxious and happy to entertain you. It seems fitting that we should have you within our gates long enough to show you the power we generate and send out for manufacturing. We have two large companies; one delivers current to our Buffalo neighbors, some 20 miles distant, and the other runs electric cars 14 miles in another direction.

"While the last few years have seen great strides in the commercial use of the great cataract, as long ago as 1725 the French sawed lumber here with power from Niagara River to build old Fort Niagara. From that time forward more or less use has been made of this wonderful fall of water.

"With some 200,000 horse power being developed by the two companies we will have enough power to run a great many factories, and we expect that you gentlemen in the near future will be knocking at our doors to obtain power to operate your roads for hundreds of miles about us. The roar of Niagara was heard in New York on a telephone. Why not the same energy in larger quantities and commercially? We are generous and trust you will call on us for all you want.

"I have this week seen a report of the New York State Railroad Commission of 1893, and find that our local road, the Niagara Falls and Suspension Bridge Street Railway company, was chartered October 20, 1882, this being their fifteenth anniversary, or crystal wedding, as it were. They have a chance to give thanks that they are alive and healthy. From the same report I find the capital invested in '93 was something over $100,000,000, with some $20,000,000 gross income in New York state alone, but I also find your business was not very much better as to net profits than a great many others in that year. From the general air of prosperity, as shown in your faces, it must have improved, and I trust it will keep on improving.

"We appreciate the honor of your visit and want you to leave with such an impression that the memory will always be pleasant. Remember the latchstring is always out for you, and we trust you will come again, individually and collectively. We wish you all success in your deliberations. May your association grow and flourish like a green bay tree. The gates of the city are wide open to you, and the only restriction made is, that if you find anything bolted down, please leave it.

"Personally, it is a pleasure for me to meet and welcome you, and I trust to have that pleasure again."

The following-named companies then acquired membership in the association: Nassau Electric Railroad company, Brooklyn, N. Y.; Binghamton Railroad company, Binghamton, N. Y; Buffalo Traction company, Buffalo, N. Y.; Roxborough, Chestnut Hill and Norristown Railway company, Philadelphia, Pa.; Chester Traction company, Chester, Pa.; Colorado Springs Rapid Transit company, Colorado Springs, Colo.; Southwest Missouri Electric Railway company, Webb City, Mo.; Union Traction company, Anderson, Ind.; Atlanta Railway company, Atlanta, Ga.; Wakefield and Stoneham Street Railway company, Boston, Mass.; Mystic Valley Railway company, Boston, Mass.

The president called attention to the fact that the minutes of the last meeting were issued within 30 days after the adjournment of the St. Louis meeting. The minutes were approved as printed.

President McCulloch then read the address of the president.

President McCulloch's Address.

After an introductory reference to the industrial revolution accomplished at Niagara Falls, Mr. McCulloch said:

To keep our place in the procession we must join in the cry of "The king is dead! Long live the king!" We must discard the old and adopt the new, or else be ground under the wheels of this juggernaut of progress. Unfortunately, if we endeavor to "shun Scylla, we are in danger of being wrecked on Charybdis;" hence we assemble here to counsel together as to how we may best shape our course. To learn more of this revolutionary factor in our business, to discuss this and other kindred subjects, to compare our experiences, to meet and greet each other, to renew old friendships and acquaintance, and to form new ties, to be forced, if need be, to recognize that "there are other pebbles," to find that the American Street Railway association is filled with men to know whom is both an honor and a pleasure—these, my friends, are some of the things which have brought us together, and it is hoped that a full measure of pleasure and profit will reward all who honor us with their presence.

Our local brethren, with a hospitality as abounding and exhaustless as the never-ceasing flow of their great river, have provided for our physical comfort and entertainment. We beseech them not to seduce us from a proper contemplation of the business before us.

Our noble ally, our helper in all the good work we accomplish, our always alert, jovial and genial friend, the supply man, has contributed, as usual, his share to our entertainment and enlightenment. He is here to show us the best of everything he has. He is not, in one sense, a member of our association; he does not participate in our deliberations; but he stands at our threshold, and the vigilance which he exercises, that none may escape, is worthy of our emulation in the conduct of our business. Let us show our appreciation of his efforts by inspecting his wares, by loading him with orders and by fraternizing with him, that his enjoyment of the occasion may be equal with ours.

We have still another and a new element in our gathering for this year. While we are here engaged in the discussion of questions pertaining to the construction, equipment and operation of the roads and interests in our keeping, there is assembled near by, and also in deliberative convention, an earnest, intelligent, enthusiastic body of mostly younger men than ourselves. They have in view the same objects which bring us together—a betterment in the performance of street railway work. Their duties, while distinct and apart from ours, are just as essential, and the requirement is for the same degree of intelligence, industry and integrity. Their organization is young, and they are just starting out in their efforts to enlighten each other by a mutual interchange of information as to methods and ways. I allude to the Street Railway Accountants' association. Let us not extend to them the right hand, but both hands, and help and encourage them to persevere in their good work. Their interest and efficiency in the performance of their duties is susceptible of the same betterment by convention as ours. If they find it desirable and convenient to meet at the same time with ourselves, and thus extend the acquaintance and good-fellowship between the operating and accounting departments which must result from contact, let that arrangement continue; but if it be considered wiser to have two separate meeting times and places, that may be the plan; but they should have our encouragement and indorsement, and even financial support, if necessary.

Our meetings are always attended by quite a number of persons engaged in the same business as ourselves, but whose companies are not members of the association, and we receive requests for information from the same source, which information is always cheerfully given. We would not like to close our doors against these non-members, but we would be glad to enter their names in our official lists, and their annual dues, which is only a small amount, would fill an aching void in our treasury.

There is still another class who, although members of our association, seldom or never grace our meetings with their presence. Whether this may be from a lack of time, a feeling of exclusivenes or a consciousness of a possession of all the knowledge attainable concerning our business, I know not. But if the first, an effort and sacrifice might be made experimentally; if the second is the cause of their absence, a surprise and discovery is in store for them if they will only develop it. And if the last reason keeps them away, a feeling of charity and good will for their fellow-laborers should impel them to come among us and show us how to surmount our perplexing obstacles.

The questions to be discussed in our convention have been selected with reference to newer developments and applications. The gentlemen honored by selection (and the honor should be much coveted) to prepare papers have all been urged to be present and personally present their efforts, thus giving them a force that can only be imparted by the enthusiasm of the author. Time will be given for the presentation and discussion of each paper, and it is hoped the discussions will be free and exhaustive.

I wish that my successor in office may have a secretary and executive committee who so thoroughly realize and faithfully perform their duties as have the secretary and executive committee who have assisted me in the performance of my very pleasant work.

And now, my friends and brethren, thanking you you with more earnestness than my language can express for the unexpected honor with which you crowned me a year ago, and promising an impartial ruling on all questions presented, we will proceed with the business of the convention.

Tuesday's Business.

The secretary read letters of regret from Thomas Lowry of Minneapolis and C. Densmore Wyman of New Orleans.

H. H. Littell of Buffalo presented the following resolutions, which were unanimously adopted:

Whereas, The American Street Railway association, through the report of its president, has been officially informed of the organization of the Street Railway Accountants' Association of America; and

Whereas, The aims and objects of that association are to bring together those engaged in the accounting department of street railways for the interchange of ideas, to promote the adoption of a simple, concise and uniform system of accounts, and to improve the work of the accounting department; and

Whereas, That association is now in convention assembled in this building; therefore be it

Resolved, That the American Street Railway association, believing that the attainment of the aims and objects of the Ac-

countants' association will be of permanent benefit to the street railways of America, heartily endorses and approves of the organization of that association, and pledges it their cordial encouragement and support.

This concluded the routine business on hand, and the reading of papers was announced as the next feature. The first paper was on "Municipal Ownership of Street Railways," by P. F. Sullivan, general manager of the Lowell and Suburban Railway company of Lowell, Mass. This is a subject to which Mr. Sullivan had given considerable personal attention, and he had gone to great trouble and expense to procure information on this subject. The secretary read the paper. A vote of thanks was extended to Mr. Sullivan for his able paper.

The next paper considered was "Some of the Difficulties Existing in the Construction and Operation of Electric Street Railways." It had been prepared and was read by G. W. Knox, electrical engineer of the Chicago City Railway company. Owing to the lateness of the hour, the paper was not discussed, but President McCulloch took occasion to extend the thanks of the association to Mr. Knox for the careful consideration he had given the subject and the excellent manner in which he had presented it. H. H. Littell of Buffalo, speaking on the same subject, said: "I think that the paper just read commends itself to every street railroad man, whether he be president, general manager, or superintendent of a company, and especially if he be the electrician. The paper should be read carefully and studied carefully, as it is very important, particularly the point about calling the heads of departments and employes together. I have been practicing that for a good many years, and we have a school every morning. We not only talk over matters, but we discuss them, and the practice is attended with a great deal of good. It is certainly a great benefit to our company, and consequently to the public, and I think that this paper should be given a great deal of careful consideration."

This concluded the first session, the convention adjourning until 9:30 a. m., Wednesday.

STREET RAILWAY EXHIBITS AT NIAGARA FALLS.

Wednesday's Session.

When the second session was called to order on Wednesday morning at 10:30 o'clock, the auditing committee reported that it had examined the accounts of the secretary and treasurer and found them in satisfactory condition, the cash balance being $2,931.48. Mr. Penington was commended for his excellent work in this important department.

The first order of business was the reading of the paper on "Storage Batteries and Their Application to Electric Traction," by Charles Hewitt, electrical engineer of the Union Traction company of Philadelphia. Mr. Littell of Buffalo asked consent to have the storage battery men address the convention, but objection was raised on account of the lateness of the hour, and the discussion was dropped. A vote of thanks was tendered Mr. Hewitt for his able paper, and President McCulloch took occasion to thank him for personally presenting it and answering the questions which it prompted. Additional force and value was given the paper this way, he said.

The president announced that the next paper on the programme was on "Power Distribution and Use of Multiphase Current Transmission for Ordinary Street Railways," by Maurice Hoopes, electrical engineer of the Lynn and Boston Railroad company of Lynn, Mass. Mr. Sergeant explained that Mr. Hoopes intended to be present and read his paper and answer questions, but that he had been compelled to abandon his work and go away for recuperation. In his absence the secretary read the paper. At the conclusion Mr. Kelly of Columbus presented a vote of thanks to Mr. Hoopes for his able paper, which was unanimously adopted, and a telegram was sent to Mr. Hoopes congratulating him on the paper, and expressing the hope that he would soon be restored to health.

The last business of the day was the appointment of a committee upon nomination of officers and selection of next place of meeting. There had been considerable rivalry between Boston and Cincinnati, and the friends of Detroit and Omaha were also active. The committee met in the evening and had a long session, but did not make known its decision until Thursday morning.

Thursday's Session.

The third day's meeting was the most important and interesting session of the convention; the attendance was larger than at any other meeting and interest was maintained throughout. Three papers were read, the first being by George H. Davis, superintendent of the Canal and Claiborne Railroad company of New Orleans, on "Discipline of Employes," and was followed by a brief discussion. The second paper was on the "Application of Electricity to Railroads Now Operated by Steam Power," by H. N. Heft, president of the Meriden Street Railway company of Meriden, Conn. This paper described the equipment of a part of the New Haven system which was recently transformed into an electric road. Col. Heft announced that any data, diagrams, maps or information of any kind that the members desired would be gladly furnished by the company. The last paper of the convention was read by W. J. Hield of the Twin City Rapid Transit company of Minneapolis. It was a carefully prepared article upon the "Best Method of Settling Damage Cases and Prevention of Accidents by Use of Fenders or Otherwise." This concluded the programme. The association extended a vote of thanks to each of the gentlemen who had contributed papers to the meeting.

The question of having the papers prepared in advance and printed in pamphlet form for distribution among the members was brought up and provoked quite an animated discussion. W. Worth Bean of St. Joseph opposed the innovation on the ground that much of the interest in the meetings would be lost. This view was entertained by other influential members, and when the question was put to a vote it was overwhelmingly defeated.

The committee on nominations, through Col. Henry M. Watson of Buffalo, presented its report, which recommended the selection of the following-named gentlemen for the offices mentioned:

President—Albion E. Lang, Toledo, Ohio.

First vice-president—W. Caryl Ely, Niagara Falls, N. Y.

Second vice-president—John A. Rigg, Reading, Pa.

Third vice-president—E. G. Connette, Nashville, Tenn.

Secretary and treasurer—T. C. Penington, Chicago.

Executive committee—Robert McCulloch, St. Louis; C. Densmore Wyman, New Orleans; H. C. Moore, Trenton; John. M. Roach, Chicago; Robert S. Goff, Fall River.

The selections were confirmed by a unanimous vote, and Boston was named as the place for holding the next meeting.

Friday's Session.

The newly elected officers of the association were introduced and installed in their respective positions, with the usual exchange of courtesies, after which the convention was adjourned.

Entertainment of Visitors.

It was generally agreed that the committees in charge of the arrangements had provided plenty of entertainment and of sufficient variety to please everybody. For the ladies there were drives and trolley parties during the day, musical entertainments and dancing in the evening, and a reception given at the International Hotel by the ladies' entertainment committee. The Whirlpool Rapids proved a great attraction, and as the weather was favorable, there was a constant stream of visitors to that interesting spot. Many of the ladies accompanied the gentlemen on their visit of inspection to the power house and the numerous factories that have sprung up since the development of power at Niagara Falls was begun.

The exhibition hall proved to be the main attraction for the delegates and no exhibitor was slighted. Many of the exhibitors dispensed attractive souvenirs of the convention in the way of card-cases and note-books, badges, etc. There was a great demand for these articles.

The programme of entertainment as outlined in the Western Electrician was closely followed, and many other features were added by the manufacturing companies. The General Electric company, for instance, had an X-ray display at its hotel headquarters which interested and amused many.

The principal social feature, of course, was the banquet on Thursday evening, which proved a most enjoyable affair.

The new Jamaica cable is promised for January next. A company has been formed under the title of the Direct West India Cable company, for the purpose of connecting the islands of Bermuda, Turks Island and Jamaica by a cable which will afford direct telegraphic route to Canada and Europe by means of the Halifax and Bermudas company's route and the different Atlantic lines.

Convention Gossip.

Charles T. Burns of Rochester, N. Y., who represented the "Board of Trade" as well as his business interests, announced that Tom Christy and George Belknap and other distinguished members of that influential body deeply regretted their inability to be present.

T. C. Penington is a model secretary, and he is entitled to great praise for the manner in which he arranged the programme and ensured the presentation of the papers read before the association. The newspaper men especially are under obligations to him for many courtesies.

Dan Hemingray of Covington tried to make the delegates and visitors believe he belonged at Cincinnati. The Kentucky colonel was very much interested in the contest over the selection of the meeting place for 1898, and his enthusiasm for Cincinnati led him to repudiate his connection with Covington. It is feared that Dan will have considerable difficulty in explaining the situation on his return home.

The International Hotel was the headquarters of the association during the convention. This hotel is the favorite resort of the street railway men. It has accommodations for 600 guests, and on this occasion special provision was made for the delegates and their friends. The house was turned over to the street railway men practically, as the regular season had closed. Mr. Greenwood, the manager of the hotel, was indefatigable in his efforts to enhance the comfort of his guests.

Button, button! who's got the button? The association badges were in great demand, as everything in the city of Niagara Falls and the neighboring country was free to the possessors of these magic buttons, and conductors on the Buffalo street railway lines refused to accept fare from them. On the Great Gorge route, the lines in Niagara Falls and the trolley road between that city and Buffalo conductors had been instructed not to accept fare from the visiting street railway men.

Much interest was shown in the details of management of the Buffalo Street Railway company's plant. There was one feature especially that attracted the attention of those who took a ride over the trolley line between Niagara Falls and Buffalo. All of the cars on this line have fenders, but in appearance at least they do not inspire confidence. Indeed, it is doubtful if they do not add to the danger. A good deal of time is consumed in carrying the fenders from one end of the car to the other at each end of the line, and two men find it difficult to make the change.

Detroit seemed to make no special effort to induce the association to pronounce in its favor. It was explained that the representatives of the Wolverine district felt that they were entitled to the honor, as they had already showed their loyalty to the association on the occasion of one city finding it wellnigh impossible to comply with the requirements. Although it was late in the season, Detroit offered to take the convention and provide an exhibition hall, entertainment, etc., but fortunately it was not found necessary to make a change. However, Detroit showed its good-will, and it was believed it was entitled to some consideration.

Elmer P. Morris furnished considerable amusement for the visitors. His "personal representative," who has the distinction of being the "tallest black man" in western New York, visited the convention hall accompanied by a brass band and displayed an announcement that there would be a hot time in the old town as long as he remained there. He kept his promise, and wherever the red-headed darkey appeared he was sure of a crowd. Tuesday night the E. P. M. band gave serenades on every floor of the International between 11 and 12 o'clock, as it was feared that some of the visitors who retired early might feel slighted if they were not permitted to enjoy the music.

Boston—dignified, cultured Boston—made a bid for the convention of 1898 in true Boston style. No brass bands, no colored posters, no badges, no boomers were employed in this campaign. The modern Athens appealed to the intellect and to the imagination of the members. Its claims to distinction were set forth in verse—it could scarcely be dignified with the name of poetry, even with the Boston stamp of approval. Here is an example:

We'll show you modern railway lines
That cover many miles,
And try and win you over,
From woolly western wilds.

One gentleman remarked that if Boston failed to get the convention the blame could be laid at the door of the man who perpetrated this literary outrage.

Buffalo street railway men are greatly interested in the outcome of the mayoralty contest in that city. One of the candidates, John N. Scatcherd, is said to be largely interested in street railway securities and also in the local electric lighting system. Mr. Scatcherd has been vigorously opposed because of his interest in corporations enjoying special privileges in the way of franchises, but he has publicly declared his intention to withdraw from these enterprises in the event of his election. At a public meeting last week he made the following statement: "There is one thing I want to speak about in connection with this campaign. It has been charged that I am too closely identified with corporations to become a good mayor. With regard to that I have to say that I own stock in only one corporation which in any way comes up in connection with the government of the city, and that is the Buffalo Street Railway company. I have said before and now repeat, that if I am elected to the office of mayor of this great city I will immediately sell my stock in the Buffalo Railway company, tender my resignation as a director, and be ready to see that the rights of the citizens are protected whenever any matter may come up, any controversy occur, which would seem to be detrimental to the citizens." It is believed that Mr. Scatcherd will be elected.

Notes of Exhibitors and Exhibits.

"Gold Bond" J. M. Atkinson did the honors for J. M. Atkinson & Co. of Chicago.

Electrical Engineer E. P. Roberts of Cleveland found time to drop in at the convention.

Secretary J. S. Crider of the Washington Carbon company of Pittsburg was an interested attendant.

President Charles E. Bibber of the Bibber-White company of Boston was among the most welcome visitors.

It was expected until the last moment that the Commercial Electrical Supply company of St. Louis would send a representation, but pressure of business at the home office prevented the arrival of either President Franklin or Manager of Sales Cable.

General Manager McBrier of the Ball Engine company of Erie, Pa., was looked for all through the convention.

John T. McRoy, the ubiquitous clay conduit man, was "everywhere," extending to his friends his usual hospitality.

J. O. Crane of Holmes, Booth & Haydens of New York and Waterbury, Conn., spent his time at Niagara to good effect.

George D. Rosenthal, manager of the St. Louis department of the General Electric company, was on the ground at all times.

President Page, of the Page Iron Works, was, as usual, on hand, although he had not expected to put in an appearance.

P. C. Ackerman of Providence and Frank B. Baker of New York, of the American Electrical Works, arrived at the Falls.

F. G. Fuller represented W. R. Brixey of Day's Kerite. Mr. Fuller was warmly welcomed, and there were many inquiries for "Brixey."

The Consolidated Car Heating company of Albany, N. Y., presented each delegate a ground plan, showing the location of the various exhibits.

John A. Roebling's Sons company was well represented. Western Manager George C. Bailey of Chicago, together with Messrs. Walsh, William Doyle, from the mills, also Messrs. Cockey and General Manager Shippy did the honors.

Edward P. Sharp of Buffalo, the second-hand railway material man, made a hit through his sign "Any old thing you may want," over his exhibit.

President Samual W. Glover, of the Post-Glover Electric company of Cincinnati, worked hard for his home city as the city of the next convention.

Of course the Central Union Brass company of St. Louis, Mo., was on hand, and Manager T. C. White of the electrical department did the honors in true southern style.

The Forest Electric company of Cleveland made a handsome exhibit, and it was a matter of regret that W. B. Cleveland was not present to hear the favorable comments of visitors.

Treasurer F. M. Laughlin made no exhibit, but the Solar Carbon and Manufacturing company found in him a representative capable of doing the honors to its many friends in royal style.

The Safety Insulated Wire and Cable company was represented by M. B. Austin, Chicago manager, and Lieut. E. J. Spencer of St. Louis. Mr. Austin was envied by his competitors for more reasons than one.

A new cleansing compound for cars appeared under the name of "Kleanit." This was presented by the Kleanit company of Akron, Ohio, under the representation of W. F. Dressler. Mr. Dressler called attention to a long list of roads that found this substance of decided value as an aid in cleaning cars.

STREET RAILWAY EXHIBITS AT NIAGARA FALLS.

The Rochester Car Wheel company had a number of trucks equipped with its wheels, and its representative, Mr. Russell, directed attention to the merits of the company's product.

Arthur Hartwell, the energetic manager from the Westinghouse Pittsburg agency, put in an appearance Wednesday. It is needless to say that Mr. Hartwell was one of the best-known men at the convention.

Holmes' Tesoline, the new commutator compound now being exploited by the Boiler Expurgator company of 115 Dearborn street, Chicago, would have found the present convention an excellent opportunity, as there were many inquiries for it.

Western Manager J. G. Shainwald of the Standard Paint company accompanied the Chicago delegation. Mr. Shainwald, as usual, distributed attractive souvenirs, and there were few present that did not know of the many advantages of "P. & B."

The Edison-Brown Plastic Rail Bond company of New York came to the front with a handsome exhibit. This bond has met with remarkable favor in the hands of street railway men, and the company is naturally proud of its great and continuous success.

Manager of Sales E. H Abadie, of the Wagner Electrical Manufacturing company, was unable to put in his appearance. Mr. Abadie is a constant attendant at electrical conventions, but this time matters of importance caused him to remain at home. The Wagner company reports of late an extraor-

dinary increase in business, and Mr. Abadie's responsibilities keep him close to his desk at the St. Louis headquarters.

Manager Isaacs of K. McLennan & Co., manufacturers of Gale's commutator compound, made arrangements to have his circulars distributed at the convention, and, as a consequence, "Gale's commutator compound" was decidedly in evidence.

Secretary and Treasurer King looked after the interests of the Ohio Brass company, and took great pride in its very handsome exhibit at the hall. Mr. King is an indefatigable worker and deserves the success which has attended his efforts during the last few years.

Frank Donohoe, western manager of the American Electrical Works, as usual, was everywhere. Mr. Donohue is one of the most popular western representatives in the wire business, and he was kept extraordinarily busy taking care of his host of street railway friends.

Whyte of the Leschen-Macomber-Whyte company came down on the Wabash train, on his way abroad to join his wife at Hamburg. He left a memento that was greatly appreciated, in the shape of a cunning little advertisement, entitled "The Clink of the Ice," by Eugene Field.

The Skeen automatic safety electric signal system and the Skeen automatic magnetic regulator were exhibited under the care of the inventor. The Skeen regulator is designed to be used on lighting and heating circuits, to keep lamps and heaters in service at a constant potential, overcoming the dropping and flaring of the light. The Skeen company is now manufacturing its product at 3023 North Broadway, St. Louis.

A. L. Daniels, the energetic and ubiquitous representative of the H. B. Camp company of Aultman, Ohio, made an interesting exhibit, illustrative of the merits of Camp's underground and interior conduit. Mr. Daniels reports that his company's conduit is meeting with phenomenal success.

Capt. Willard Candee of the Okonite company not only sent a pleasing exhibit in the shape of "feeders" that attracted considerable attention and complimentary comments, but he did the honors in person. A convention would not be complete without Captain Candee of Okonite fame.

Vice-president and General Manager Joseph N. Thomas did the honors, and royally, too, for the Steel Motor company of Johnstown, Pa. Mr. Thomas has only recently assumed his present responsible position, but already the increase in the company's business would indicate that he is well fitted for it.

Albert Mann, the Buffalo agent of the Standard Thermometer and Electric company of Peabody, Mass., made an attractive exhibit at the convention hall of Upton "Midget" enclosed arc lamps specially adapted for street railway connections. The company manufactures open arc lamps for all circuits as well.

Forsyth Bros. & Co., railway supplies of Chicago, were faithfully represented by W. H. and G. H. Forsyth. This concern is energetically and agressively pushing the merits of the original Forsyth patent roller-tipped car curtain fixture. This device has met with favor, and was adopted and used extensively by nearly all the leading railroads and many of the street railway companies; in fact, they make a point of reminding people that the Forsyth fixture has been complimented by the sincerest of all flattery—imitation.

Secretary and Treasurer Ferguson of the Walker company of Cleveland was on hand early Wednesday morning. It must have been exceedingly gratifying to Mr. Ferguson to hear the many favorable comments on the fine exhibit made by the Walker company. The Walker company put its best foot foremost.

The Fuel Economizer company of Matteawan, N. Y., exhibited sample castings which, with a perfect little model, perfectly illustrated the use and construction of this machine for utilizing the waste heat for heating of boiler feed. P. J. Challen of Matteawan, N. Y., made a good impression as a representative.

The ubiquitous Hurd of course had charge of the Crane company's exhibit of Chicago. If there is any place of any importance in the way of any town or city that Mr. Hurd does not touch during his travels, it would be hard to mention. Of course he is the man who did the honors at the Niagara convention.

The duplex car was shown for the first time at a street railway convention. It was operated on the lines of the local company and on the Great Gorge route for the accommodation of the visitors. Only persons wearing badges were permitted to ride on this car. The construction of this car has already been explained in the Western Electrician. It is rather an odd-looking affair and attracted considerable attention.

STREET RAILWAY EXHIBITS AT NIAGARA FALLS.

J. Paul Baker, secretary and treasurer of the Baltimore Car Wheel company, came up from Buffalo, where he was spending a few days, on Thursday, and mingled with the boys at the International.

The New York Car Wheel Works of Buffalo made an extensive display, the special feature of which was its interurban wheel, especially designed and constructed for electric lines. This wheel, it was stated, was the result of extensive observation and experiment, and it has been found to be particularly well adapted to interurban service.

President James F. Cummings of the Armorite Interior Conduit company, having stated that he would be likely to be at Niagara, was daily expected. One of Mr. Cummings' intimate friends has referred to him as the "conduit king;" and somehow the appellation fits him to a "T," for he certainly is not only a keen business man, but is recognized as a "prince of good fellows."

"Richards," who is recognized as a most aggressive salesman for the Safety Insulated Wire and Cable company of New York, spent Tuesday at Niagara, and he left a "trailer" behind him in the shape of a fine letter of recommendation for Safety wire from James R. Chapman, manager of the electrical department of the North Chicago and West Chicago Street Railway companies. These letters were found under the doors of practically every room of the International Hotel when the occupant awakened on Wednesday morning.

The International Register company of Chicago made a handsome exhibit of its product under the care of Manager A. H. Woodward. The car register exploited by the International company has many important and valuable features. Without going into details of construction, it may be said that it is deserving of a most careful investigation on the part of conservative railway men.

Bailey Whipple appeared in the interest of the Buckeye Electric company of Cleveland and also the Jandus Electric company of the same city. Mr. Whipple was constantly on hand and has made many friends for his company. As is well known, the Buckeye is highly thought of in electric railway circles, and Mr. Whipple did good work in adding to the company many friends.

General Manager James Partridge and President D. F. McIntosh of the same company royally did the honors for Sandusky. Dr. McIntosh is one of the most prominent physicians of Sharpsburg, Pa., and being a man of great genialty, he and Mr. Partridge added greatly to the popularity of the Partridge Carbon company. Their "Scratch him on the back" advertising scheme made a hit.

If there was a man at the convention that had a greater fund of good humor, could tell better stories or sound the praises of his company in a happier vein than W. H. Gray of the western office of the Peckham Motor Truck and Wheel company, he was hard to find. Like the old woman who lived in a shoe, if Mr. Gray makes any more friends he will not know what to do with them.

Up to the last moment it had been expected that Manager Tucker of the sales department of the Western Electric company would join the party on the Wabash special from Chicago. Pressure of business, however, prevented Mr. Tucker's attendance, and it was a matter of regret that he did not appear, as he is a man of many friends, and has made a mark in the street railway world.

Gustave Fischer was a welcome visitor at Niagara. Mr. Fischer is the chief assistant engineer for tramways at Sydney, Australia, and he took the splendid opportunity of the street railway convention to post himself in a comprehensive manner on the most modern street railway machinery of the world. Mr. Fischer has been in this country two months, and expects to be in Chicago in about two weeks, whence he will proceed to Vancouver to sail to Australia.

One of the smallest exhibits, yet one that attracted much attention on account of its novelty, was the Cravath excessive current recorder, for keeping tab on motormen, shown by J. R. Cravath, president of the Cravath Manufacturing company, 825 Monadnock building, Chicago. This is the first convention at which anything for this purpose has been exhibited, and it marks one of the advances of street railway practice during the year.

A. W. Morrell of the electrical department of the Miller-Knoblock company of South Bend, Ind., illustrated the merits of his methods of refilling commutators by an improved hydraulic process. Mr. Morrell has only recently connected himself with the Miller-Knoblock company, and will have the management of their special electrical department. Those interested in commutators, their construction and troubles, will find Mr. Morrell's process of decided merit, and well worth a little investigation.

Secretary and Treasurer A. C. Garrison of the Columbia Incandescent Lamp company of St. Louis, contrary to expectation, appeared at the International Hotel and was on deck at all times during the entire convention period. Mr. Garrison made no exhibit at the hall, but he brought with him a special Columbia railroad lamp. The Columbia Incandescent Lamp company is noted for the high character of its productions, and this special railway lamp was an object of interest to Mr. Garrison's many friends.

Townsend V. Church looked after the interests of Julian L. Yale & Co. This concern deals in railroad supplies and steel rails, and is also in the business of relaying rails. Mr. Church and Mr. Yale formed this company last February, both gentlemen having been, previous to that time, prominently connected with the Illinois Steel company of Chicago. Mr. Church made many friends for his new and thriving institution. The extended experience of these gentlemen in the steel business should insure success to the new enterprise.

The Creaghead Engineering company of Cincinnati, Ohio, made, as usual, a very complete display of flexible brackets in both plain and ornamental designs. These brackets are accepted as a standard on high-speed roads and are manufactured in the best possible manner. The company also exhibited a full line of overhead material, malleable iron pole fittings, section insulators and strain insulators. The booth was handsomely decorated and in charge of the company's superintendent, G. R. Scrugham, who distributed as a souvenir a very neat steel pocket rule in a leather case.

[*Continued on page 233.*]

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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tate of Illinois, County of Cook—ss:

Thomas Jansen, being duly sworn, deposes and says that he is a resident of the city of Chicago, in the county of Cook and state of Illinois, and that he is the foreman of the printing department of the Electrician Publishing company, the publishers of the Western Electrician; that he was present at and superintended the printing of No. 24 of Vol. 20 of the Western Electrician, issued on June 12, 1897, and that there were printed by actual count 20,000 complete copies of said Western Electrician of the volume and number above specified. And further this affiant sayeth not.

THOMAS JANSEN.

Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

Four Years' Record of Electric Light Convention Advertising.

Issue	Number of Advertising Pages.	Whole Number of Pages.	Square Inches of Paid Advertising Matter.
March 3, 1894....	40	56	4,145
February 23, 1895.	52	68	5,593
May 9, 1896.....	72	88	7,576
June 12, 1897.....	80	100	8,643

No other electrical journal has ever equaled this record of 8,643 square inches of genuine full-paid advertising in a single issue.

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Careful estimate places the number of delegates and visitors at this week's convention of the American Street Railway association at 1,000. No more impressive indication of the importance of the industry could be asked. In other respects the gathering was a notable one; the papers were practical and useful and the exhibits varied and interesting. It was a great convention—practically a great electrical convention.

The airy, nonchalant manner in which the Chicago daily newspapers dismiss the question of municipal ownership, as applied to electric street lighting in Chicago, is rather amusing. Listen to the News, for instance: "While $50 per annum represents the annual expense of furnishing the electric lights now operated by the city's plant, those operated by the companies cost from $105 to $137.50 per lamp. Fortunately the city has a wideawake mayor and a trained business comptroller, who are able to see the absurdity and prodigality of paying the electric lighting companies two or two-and-a-quarter times the sum for which the city could, had it a sufficient plant, furnish the lights." There is the whole problem disposed of in two sentences! We can do it for ourselves for $50, and the companies charge us two and two-and-a-half times as much. Why shouldn't we own and operate our own plants? But we may well pause to question, Are the facts correctly stated? Doesn't it cost the city of Chicago more than $50 per light to maintain its electric lighting plants when all the items of expense are fairly taken into account? We think that it does. Detroit is conceded to possess the model municipal plant of the country, and there the cost has been shown to be nearly $100 per light. There are weighty questions of public policy and vested rights to be considered in this municipal-ownership discussion, but, aside from these, considering merely the cost to the taxpayers, it is yet to be proved that any great advantage lies in aldermanic control.

President McCulloch, in his annual address at Niagara Falls, made an appreciative reference to the presence and work of the supply man at the conventions of the American Street Railway association. He alluded to the supply man as "our helper in all the good work we accomplish," and said: "Let us show our appreciation of his efforts by inspecting his wares, by loading him with orders and by fraternizing with him, that his enjoyment of the occasion may be equal with ours." This utterance displays the right spirit. The manufacturing and supply companies add greatly to the importance of the annual gatherings of such bodies as the American Street Railway association and the National Electric Light association. They contribute to the material and financial success of the associations, too, often directly and always indirectly. Their exhibits are yearly expositions of progress in the art and have a great educational value. Many members learn more from inspecting the exhibits than by listening to the reading of the papers, valuable as the latter are. The papers and discussions are reprinted and are available to all after the convention, but one must be on the spot to see the exhibits, to compare one type of apparatus with another, to see what improvements have been made. Thus the supply man's side of the conventions is of much value. Even if the exhibitor has an entirely selfish end to serve, his efforts add so much to the usefulness of the gathering that he is entitled to the cordial co-operation of the association. And, indeed, who is there who attends a convention without a selfish interest?—who does not go to receive some benefit? The supply man pays his score, shows his goods and does his share to make the convention interesting, bright and profitable. It is a great mistake to underrate his work—to sneer at the "hazaar," as has been done—and it is a pleasure to note that Mr. McCulloch took occasion to voice his appreciation of the help of the supply man.

Judges have been heretofore rather in doubt whether sciagraphs were competent to be admitted in evidence in courts of law. Differing views have been held in various localities as to the legal credibility of the X-ray pictures, but the weight of authority seems now to indicate that a properly authenticated sciagraph is as admissible as a photograph. An interesting case in point was recently decided by the court of last resort in Tennessee. In the process of the trial of a personal injury case, a physician was called as a witness, and he was permitted to submit to the jury an X-ray picture taken by him, showing the overlapping bones of one of the plaintiff's legs at the point where it was broken by the fall, to recover damages for which the action was brought. This picture was taken by the witness, who was a physician and surgeon, not only familiar with fractures, but with the characteristics and use of the X-rays. He testified that the picture accurately represented the condition of the leg at the point of the fracture in question, and, as a fact, that by the aid of the X-rays he was enabled to see the broken and overlapping bones with his own eyes, exactly as if, stripped of the skin and tissues, they were uncovered to the sight. Objection was made to this testimony. But, verified by this picture, the Supreme Court of Tennessee held that it was altogether competent for the purpose for which it was offered. The court says that, new as this process is, experiments made by scientific men have demonstrated its power to reveal to the natural eye the entire structure of the human body, and that its various parts can be depicted, as its exterior surface has been and now is. Nor did it consider that any sound reason had been assigned why a civil court should not avail itself of this invention, when it was apparent that it would serve to throw light on the matter in controversy. It is not to be understood, however, adds the Supreme Court, that every picture offered as taken by the cathode or X-ray process would be admissible. Its competency, to be first determined by the trial judge, depends upon the science, skill, experience and intelligence of the person taking the picture and testifying with regard to it, and, lacking these important qualifications, it should not be admitted; and, again, even when it is not conclusive upon the triers of fact, it is to be weighed like other competent evidence.

An interesting telephone inquiry is in progress in Glasgow. It appears that the National Telephone company's service has been very bad, and there is a proposition that the city take over the business and operate it. Much of the testimony adduced is amusing and shows that the people of Glasgow are more patient and long-suffering than had been supposed. A professor at the university laments that he made many personal complaints to the company at all times of the night, and once found an operator intoxicated. He would not like his daughter to communicate with the exchange because she might hear bad language—other people swearing horribly at times. A leading merchant prefaced his evidence by announcing that "there are no oaths in the language strong enough to express my sentiments to your company." He personally did not want the municipality to take over the telephones. The magistrates had too much on their hands already. If they had their way, he said, they would provide midwives and hearses and take charge of the whole population. In a letter from this witness to the company he appealed to them in this strain: "Fancy your own feelings every time you try the cursed thing and twiddle away at a ——— handle that has no more result than if you were grinding a disemboweled hurdy-gurdy."

The apologists of the Glasgow system maintain that the locality is not favorable for telephone work, as the atmosphere is charged with soot, which largely destroys the efficiency of the insulators. Moreover, the moisture causes leakage, it is said. These are but poor excuses, however, for telephone service of the character that appears to have been given. Nor is there much prospect for betterment in municipal operation. The experience of government control in England seems to prove this. Says the London correspondent of the New York Sun: "Where the General Postoffice does manage the telephones it makes such a mess of it as to be reasonably suspected of playing purposely into the hands of the National Telephone company. It has had absolutely to close the postoffice telephone exchanges in such important centers as Derby, Exeter, Plymouth and Londonderry. In 1890 it had 190 subscribers at Leicester. In four years they had dwindled to 50, and last year they were 28. It is the same everywhere." The remedy seems to be the competition of private companies.

Death of Mr. Pullman.

Street railway men will take a melancholy interest in the news of the death of George M. Pullman, the founder, controlling spirit and president of Pullman's Palace Car company. Mr. Pullman died quite suddenly at his Chicago home early on Tuesday morning from a disease of the heart. His wife and children were away from home at the time.

Mr. Pullman died in his 67th year. He was gifted with business genius and achieved eminence by his own efforts, as he had no advantages of birth, wealth or influence to aid his early struggles. He possessed remarkable foresight in commercial affairs, great strength of character and a mind capable of a broad and bold outlook. He did not trouble himself with details and was dignified and deliberate in manner. It is said that he never made a public speech in his life, but those who knew him well testify that in private converse he spoke concisely and well. He was a clear-headed, determined man, and as he expected his opinions to carry weight he did not give utterance to them without due reflection, choosing his words carefully. But, if occasion demanded, he could give a quick decision. He established a great business and also the manufacturing town bearing his name, where he carried out many benevolent ideas. He accumulated wealth and is said to have given liberally to charitable enterprises.

Pullman's Palace Car company is said to be the largest manufacturing corporation in its line in the world, and it is also one of the largest of any kind in the United States. The capital stock is $36,000,000, and shares sell at about 170, while the value of the assets is placed at $63,500,000. The

GEORGE M. PULLMAN.

company employs about 10,000 persons, of whom 4,000 are in the shops at Pullman, where $200,000 is distributed in wages monthly. The principal business is the manufacture and operation of Pullman sleeping cars for steam railroads, but the company is also one of the largest builders of electric railway cars in the United States. Its activity in this line dates back to the time of Van De Poele's experiments, and Mr. Van De Poele gave his personal attention to the building of the first electric cars at the Pullman shops. Since then many types of trolley cars have been made by the Pullman company, and the tracks in the shop-yards have been the scene of a number of experiments in electric and compressed-air traction. The company also made a series of experiments in electric train lighting, principally under the direction of the late Mr. Bauer.

Mr. Pullman was one of the directors of the Chicago Telephone company.

Chicago General Electric Railway.

Affairs of the General Electric Street Railway company of Chicago are to be further investigated. Possibly a receiver may be appointed. It is charged that $350,000 has mysteriously disappeared and the Perry Hull-Lucius Clark combination will be asked to tell Master in Chancery Sherman of the United States Court just what has become of this money. Vague insinuations are made that large sums of money have been paid to the City Council to secure the General Electric franchises. The books of the company will be brought into court to see where the truth is. The complaint is made by Charles Austin Bates. The hearing has been set for November 2d. Nothing has been done in the way of construction, it is charged.

The St. Louis Car company has received a contract to build 100 trolley electric cars for the Berlin street railway of Berlin, Germany. It is reported that the same road will soon place further orders.

Notes of Exhibitors and Exhibits.

[*Continued from page 231.*]

C. R. Sackett did the honors for Niagara Falls at the exhibition hall and presented an interesting device in the shape of his automatic trolley catcher. Without going into details as to the mechanism of this simple device, it may be said that it is designed and acts to catch the poles the instant the trolley leaves the wire, thus saving delay, expense and the inconvenience of repairing crossed wires and possibly poles from entanglement through the slip of trolley poles. The catcher is made of aluminum and is consequently of surprising lightness.

Secretary and Treasurer William M. Smith of the Chicago Insulated Wire company joined the street railway contingent and came down to Niagara with the delegates on the Wabash special. Mr. Smith made no exhibit, but he added to his present large line of friends. The Chicago Insulated Wire company, located as it is, with its factory in the center of a large wire-consuming district, has been eminently successful, and no little credit is due to Mr. Smith's energetic efforts in never losing an opportunity to call attention to the merits of "Chicago" wire.

The Gold Street Car Heating company of Frankfort and Cliff streets, New York, was decidedly to the front with its host of representatives, consisting of President E. E. Gold, Treasurer W. E. Banks, Western Agent Burt Gold, Manager John E. Ward and Eastern Representative H. E. Beack. It would be impossible to give the details as to the variety of electric lighting apparatus exhibited by this concern, but it may be said that they presented almost every conceivable type and a number of designs especially adapted for modern electric street-car heating.

The popular secretary and treasurer of the Mitchell Tempered Copper company, J. G. Ruhl, put in an appearance on Wednesday. Mr. Ruhl is presenting to the trade an extraordinarily fine line of pure tempered copper castings for all systems of electrical appliances and especially suitable for street railway service. Commutator bars and segments are this company's specialty. Mr. Ruhl and his energetic manner of pushing his goods and careful manner in which he attends to all his matters have won him a nice business, which is rapidly growing.

J. S. Stevens, the well-known Philadelphian, took care of the business of the Keystone Electrical Instrument company of his city. Mr. Stevens exhibited a special board feature with voltmeters and ammeter for railway feeder service. He also presented his company's regular switchboard equipped with various instruments, a new portable direct current voltmeter and a new arc light meter and ground detector. This last device was sold at the convention, and it is rumored Mr. Stevens also closed several other handsome orders of which he made no mention.

The Adams & Westlake company was well represented as usual with an attractive exhibit, and three representatives were on hand to entertain the many friends of this popular house. The exhibit consisted of Acme car curtains, electroliers, car trimmings, headlights, signals and brake handles. H. E. Keeler, the New York manager, L. A. Gray, middle states representative, and W. S. Bartholomew, the western agent, were everywhere in evidence, and no one failed to realize that the Adams & Westlake company was fully alive to the requirements of present-day practice.

The Cutter Electrical and Manufacturing company of Philadelphia made a small but exceedingly attractive exhibit, in that there was presented for the first time a 3,000 ampere double-pole circuit breaker. This device was the center of interest in the neighborhood of the exhibit, as it was claimed to be the largest of its kind ever manufactured. Electrical Engineer William M. Scott of the company and H. B. Kirtland did the honors. It should be mentioned that there was presented a full line of street railway circuit breakers and also one for alternating circuits.

One of the most interesting and convincing exhibitions seen at the convention was the short-circuit test of the D. & W. Fuse company of Providence, R. I. A five-ampere naked fuse was short-circuited across the mains of the 500 volt power circuit, producing a brilliant though dangerous display. Immediately following this test, the representatives short-circuited one of the D. & W. fuses of 10 amperes, under similar conditions, surprising the spectators by opening the same circuit successfully without arc or flash and with perfect safety. The exhibit was in the hands of L. W. Downes and A. W. Hutchins.

Manufacturers' Agent Elmer P. Morris made a great hit through his unique advertising schemes. On Tuesday evening Mr. Morris had engaged a negro orchestra to give a concert in his parlor at the Cataract House, and the great crowd there indicated the popularity of his scheme. After the gathering had been entertained by music and in other ways a procession was formed headed by the band, and the Morris delegation made a tour of the hotels, creating quite a stir by the impromptu traveling concert. Mr. Morris is one of the most popular salesmen in the East and is meeting with great success with his various agencies.

The exhibit of the H. W. Johns Manufacturing company of New York occupied a very prominent space. The company was represented by T. Emery Meek of New York and H. Herbert Luscomb of Hartford. These gentlemen had a full line of samples of overhead material which had been adopted by many of the leading railway companies as their standard. The toggle-clamp pole insulators, with which the company has had remarkable success, were shown clamping several sizes of cables. The H. W. J. car heater was shown in operation, for which the claim of great efficiency with a minimum amount of current is made. Both panel and cross-seat heaters were shown.

The Garl Electric company was represented by Inventor Garl himself, who had a very attractive exhibit, showing the Garl street car telephone. This system is a portable one for electric railway cars, so that communications may be made direct from the car to headquarters. In case a car is disabled and away from any connection box or hook, the telephone can be carried to the nearest connection box. Mr. Garl stated to the representative of the Western Electrician that he had remarkable success, even in the short time of his exhibition at Niagara, having placed his apparatus in contact with as many as 18 roads, the majority of which placed orders with him for the portable telephone outfit.

Manufacturers and supply men had no reason to complain of lack of attention. The large exhibition hall was filled at all hours with interested visitors, and every device that possessed merit was given considerable attention. The aim of the management had been to make the exhibition a leading feature, and in this it succeeded admirably. Every delegate who attended the meetings was obliged to pass through the exhibition hall before reaching the session room. On every side there was moving machinery—mostly electrical—and competent men to explain the application of the devices to the operation of street railways. The illustrations present several general views.

The Rochester hose bridge was placed on the line of the local railway company near the convention hall in order to show the visitors that it was practicable. It attracted much attention and favorable comment. The bridge is said to be the invention of a Rochester school teacher, George F. Flannery, whose attention was called to the need of some device of this kind during a fire in the Flower City when the street car system was blocked. These bridges are placed on the tracks of the railroad and enable the cars to pass over them. Apertures in the bridge permit the placing of hose across the track. At present a fire in the vicinity of a street railway line often necessitates serious delay in the operation of cars.

The American Electric Telephone company of Chicago never loses an opportunity to make an exhibit of its most interesting line of telephone equipment, and, although the street railway convention is in one sense out of its line, it was expected at the last moment that that institution might be in some way represented. Its exhibit at the recent La Crosse electric light convention created much comment, and from the fact that the telephone is now playing such an important part in its railway equipment, it might have been an excellent opportunity for advertising. The American company, however, is simply rushed with orders at the present time, and it is hard to spare even one man from the manufacturing end of the institution.

It is no flattery to say that the city passenger and ticket agent, N. C. Keeran, and the superintendent of the dining car service, P. R. Myrick, of the Wabash road, deserved the highest compliments on the careful and thoughtful manner in which they individually and collectively watched every point in order to secure the highest enjoyment for the passengers on the Wabash special during the recent trip from Chicago to Niagara Falls. Their kind attention drew forth many comments that should have been very gratifying to them. In fact, as one gentleman remarked: "A passenger is made to feel like somebody when he goes over the Wabash." The Wabash company should greatly appreciate the services of such careful workers as Messrs. Keeran and Myrick.

An attractive and interesting exhibit was that of the Mica Insulator company of New York, Chicago and London. Prominently located at the left of the main entrance, the handsomely decorated booth presented a very attractive appearance. Commutator rings, segments, troughs, tubes, disks, plates and a variety of forms of insulation were displayed, and were of special interest to all electric railway men. The company's new product known as M. I. C. compound was for the first time exhibited. Ten different grades and styles of micanite and empire cloths and papers were shown. This is probably one of the largest exhibitions of insulating material exclusively ever made, and goes to show the progress which the company has made during the last four years in bringing to perfection this particular branch of the electrical industry. By the use of micanite in the construction and maintenance of the apparatus, electricity as a motive power has become

a phenomenal success. Charles E. Coleman of the Chicago house was in attendance and had charge of the exhibit. Franklin Brooks, vice-president of the company, was also in attendance.

The Jos. Dixon Crucible company of Jersey City occupied space No. 39, and the display of electrical graphite goods was quite extensive. Chief among these was the new graphited wood-gear grease, for doing away with all noise. This grease will not drip and ooze out of the cases, being a solid lubricant, nor will it cake in the bottom of the gear cases. It is said to last much longer and to be far more economical than former lubricants of this class. The Dixon silica graphite paint for trucks, iron and wood poles, roofs and smokestacks, was shown. On car trucks it will stand mud and sand abrasion. Belt dressing, pipe-joint grease, and graphite commutator lubricant in stick form —to prevent sparking—were also shown. A sample stick will be sent to engineers who will write for it. The exhibit was in charge of John H. Baird and A. L. Haasis.

Of course the Central Electric company of Chicago was in the front rank of street railway exhibitors. The Central Electric company has of late years paid the most careful attention in the matter of pushing a rapidly growing street railway business, and in this instance a most handsome exhibit was presented, backed by the street railway manager, W. R. Garton, and Eastern Manager H. E. Adams. It would be impossible to give a complete list of the great variety of specialties offered by this energetic house, but it may be said that the exhibit was most comprehensive. The Central Electric company is noted for carrying an immense stock, and its great specialty is prompt shipments, so much desired by purchasers of street railway material. Messrs. Garton and Adams neglected no opportunity to advertise their company in the best manner to bring trade. Regret was expressed that neither President McKinlock nor Secretary Brown could put in an appearance even for a day.

Eugene Munsell & Co. of New York and Chicago made a very fine display of India and amber mica, both in the sheet as it comes from the mines and segments for railway motors The exhibit was made in connection with that of the Mica Insulator company. A variety of segments was attractively displayed beneath a large signboard, on which was shown a full line of Van Waggoner & Williams Hardware company's drop forged copper segments, for which Munsell & Co. are general western selling agents. At the entrance to the booth was shown India mica cut in sizes from 9-16 by ⅛ to 8 by 10 inches. This large range of sizes shows that the firm is prepared to furnish mica in almost any size, shape or pattern. A souvenir in the form of a mica mine puzzle was given, and probably sought for as much as any souvenir at the convention. Street railway men not in attendance can secure these souvenirs by writing the company at either New York or Chicago. The exhibit was in charge of Charles E. Coleman of the Chicago house.

The interests of the General Electric company were cared for by the following-named gentlemen: Railway department, W. J. Clark, general manager; W. B. Potter, chief engineer; Ralph H. Beach, L. D. Tandy, J. G. Barry, Lee H. Parker, F. B. Case, W. G. Carey, E. D. Priest, F. H. Boyles and H. Kernochen, Schenectady; foreign department, Edgar Carolen; supply department, J. R. Lovejoy, general manager; H. C. Wirt, chief engineer, and J. H. Aitken; meter department, C. D. Haskins; convention committee, F. H. Kimball, secretary, Boston; T. Beran, New York; A. D. Page, manager incandescent lamp department, Harrison, N. J. The sales offices were represented as follows: New York, W. C. Bushnell and A. B. Shepard; Chicago, T. P. Bailey; Philadelphia, E. D. Mullen and W. I. Crowley; Boston, C. C. Peirce; Cincinnati, W. F. Hays and F. B. Strieby; Atlanta, S. W. Trawick and A. C. Tenney; San Francisco, F. F. Barbour; St. Louis, George D. Rosenthal; Buffalo, T. H. Fearey and D. F. Potter; Denver, Irving Hale.

Morrin Climax steam boilers are especially well thought of by street railway men because of their special features, namely: Safety, durability, steadiness of water level, accessibility and draft, perfection in mechanical construction and absence of dead points in circulation. This company is naturally quite proud of its recent success, as evidenced in the recent selection by the Trans-Mississippi and International Exposition company of Omaha, Neb., of the Morrin Climax boilers, the exposition company having recently placed an order for 3,500 horse power Morrin Climax boilers. The Morrin company is putting out at the present time a new catalogue that is of decided interest to steam users. It is a gem in its way and should be of decided interest to purchasers of boilers, as it brings out the features of the apparatus described in the fewest words. The Clonbrock Steam Boiler company was represented by President Thomas F. Morrin, accompanied by Chas. H. Sammons. These gentlemen made exhibits of portions of their apparatus and models, illustrating the many valuable features of the Morrin boiler. Mr. Morrin is a gentleman of pleasing personality, and he was on hand during the entire exhibition, together with Mr. Sammons, welcoming the rapidly growing circle of friends of the Morrin boiler. The Clonbrock exhibit was a notable one and attracted much attention. A very handsome souvenir, too, with photographs representing the Morrin boiler, was generously distributed.

The Electric Storage Battery company's space was occupied by a very interesting exhibit, showing the results to be obtained by the installation of a storage battery at the end of a feeder on a trolley line. There were arranged 55 chloride accumulators of type E 11, mounted upon insulated trays upon a rack. They were connected in series across a 110 volt circuit and wired to a white marble switchboard, which carried an ammeter (A in the diagram) in the dynamo or feeder circuit, a two-way reading ammeter B in the battery circuit, and an ammeter C in the line or trolley circuit; a double-pole single-throw switch was connected in the feeder circuit, and a similar switch F was connected in the main line or trolley circuit, across which was also connected a voltmeter G. The current in the feeder circuit was regulated by means of a rheostat H. By making and breaking the circuit at F, a variable load was obtained, representing the load on a trolley circuit. The load on the feeder remained constant, the battery supplying the current required in excess of that on the feeder and charging when the load dropped below that on the feeder, the rapid changes of charge and discharge being shown on the ammeter B. By opening the circuit at E the entire load was put upon the battery. With rapid change of load from a charge of 50 amperes going into the battery to a discharge of 200 amperes on the line, the variations in the feeder load were less than 70, and the pressure on the line remained constant. The advantages of the system in the way of saving in feeder copper,

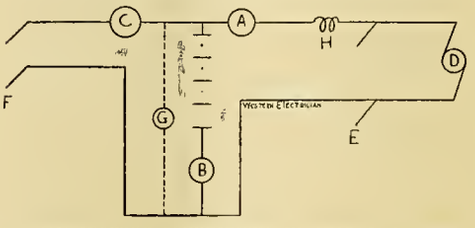


DIAGRAM SHOWING CONNECTIONS IN STORAGE BATTERY EXHIBIT.

regulation of load on the generators, and maintaining the pressure, the possibility of extension of lines, etc., were appreciated by the many street railway men who inspected the exhibit. The Electric Storage Battery company was represented by Herbert Lloyd, the general manager, J. B. Entz, F. H. Clark, Charles Blizard and J. Y. Bradbury.

In addition to an excellent equipment on the switchboard of the Walker company at Convention Hall the General Incandescent Arc Light company showed a complete line of lamps and switchboard instruments in the Cataract House. General Manager Levens, who was in charge of the exhibit, explained the workings of the numerous devices which made up this display. Principal among these were the Bergmann radial voltmeter and ground detector switches, the Bergmann radial differential voltmeter switch and the all-drawn pure copper quick-break blade switches for high amperages, mounted on finished slate bases. For railway work that requires a switch to break a large amount of current at a high voltage, past experience has shown the defect in switches now used for this work to be that the arc of breaking roughens the contact surfaces and rapidly reduces their carrying capacity, leading them to heat badly with normal loads. In this switch a form of construction is used which overcomes this objection. First, the current-carrying blades are in no way affected by the arc in breaking, as the current is broken by a separate and independent blade, and at a different point of the switch joints than that used for contact. The breaking blade is made light and under a high spring tension at breaking, which gives an instantaneous and long break, and under all conditions severs the circuit promptly and with a very slight flash, so that the current-carrying capacity of the switch is not reduced by prolonged use. The Bergmann flush push switch was also on exhibition.

At the foot of the stairs which led to the meeting hall of the convention, was the exhibit of the Westinghouse Electric and Manufacturing company, in one of the largest spaces of the entire exhibit. As usual, the Westinghouse people had a complete line of electric railway apparatus, from the standard well-known No. 3 motor to the No. 49 motor for heavy locomotive work. The special feature of the exhibit, however, which attracted the most attention, was the booster outfit, consisting of compound wound motor driving a 300 kilowatt series wound generator, with the necessary switchboard and switchboard appliances to operate the two machines. A complete line of detail apparatus, such as switches, circuit breakers, lightning arresters and fuse blocks, was distributed on a long table, each article being marked and described for the convenience and information of the visitors. There was also a large assortment of photographs on the wall, illustrating the company's factory at East Pittsburg, as well as some of the largest apparatus made by the Westinghouse company. The exhibit was in charge of W. K. Dunlap, assisted by M. McLaren, who arranged the beautiful exhibit of electric lighting apparatus which the Westinghouse company made during the convention of the National Electric Light association, held at Niagara Falls last June. The company had a large personal representation at the convention, consisting of E. T. Gray, E. H. Heinrichs, Robert Siegfried, R. F. Storer and F. H. Mallet of Pittsburg, W. F. Zimmermann of New York, C. A. Bragg of Philadelphia, J. R. Gordon of Atlanta, Paul T. Brady of Syracuse, H. F. Frenyear of Buffalo, R. S. Brown of Boston and Maurice Coster of Chicago.

The Standard Air Brake company had a striking exhibit which greatly eclipsed those of former years. Not only was it an object lesson, but it showed the great progress which that energetic company has made. As is generally known, the Standard Air Brake company was the first concern in the world to build street railway air brakes, and its exhibit practically illustrated the different types of apparatus manufactured, from the beginning of its business to date. The exhibit occupied a prominent space, between the General Electric and Brill companies, and was inspected by the majority of the delegates. The apparatus was in charge of the company's managing director, E. J. Wessels, who was assisted by the chief engineer, E. H. Dewson, Jr. The company was also represented by George E. Pratt and C. B. Fairchild, special agents, H. B. Taylor, assistant engineer, and E. E. Robinson, foreman. On entering the exhibit, on either side was to be found a Brill No. 27 truck, the one on the left equipped with the well-known duplex compressor, direct axle-driven. There are many of this type in service here and abroad. Thirty are completing their third year of active service on the Buffalo Railway company's road. On the right was shown the well-known geared compressor, which is the standard on several roads in the United States and Canada. This type has proved admirably suited for heavy traction and high speeds. Back of the duplex was shown the Standard company's hollow spindle brake cylinder with fulcrum on back head for equalizing double-truck brake rigging. A handy attachment enabled delegates to see how quickly and easily pressure can be applied. The attachment embraced a graduated spring, with a pressure indicator which showed the range from minimum to maximum, the latter being equal to an emergency stop. There was also shown the well-known Standard interlocking handle, by means of which the controlling valve was worked; also the chime whistle. This was blown from time to time and announced to delegates that the Standard company was, as usual, actively in the field. Adjoining this stood the automatic curent controller, which excited favorable comment from the numerous delegates who watched the precision and accuracy of its movements and were surprised at the narrow limits within which it operated. This device makes it unnecessary for the motorman to have any connection with cutting current in or out. Next to the current controller was shown the company's water and dust-proof electric compressor. Its freedom from vibration and noise was remarkable. The ease with which it compressed the air quickly, and the remarkably small space it occupied excited much interest. The motor compressor was piped to a 14 by 48 inch special reservoir. The company's reservoirs are guaranteed to resist a far higher pressure than is required when operating the Standard system. Next was shown a No. 1 type brake cylinder with attachments showing the manner in which trail cars are braked. In addition there was a profusion of special hose, couplers, gauges, regulators and mufflers, the whole giving a comprehensive idea of the entire Standard air brake system, and showing its remarkable simplicity as well as the substantial character of the apparatus. The company's display was augmented by views of cars and trains in different parts of the globe on which Standard air brakes are used. The company's World's Columbian Exposition diploma and medal were also displayed, and a striking sign proclaimed that the "Standard" was first in the field and the only concern which had received a diploma and medal. The Standard Air Brake company's Australian agents, Noyes Brothers, were represented by Edward Noyes, the senior partner, of Sydney, New South Wales, who was an interested spectator and gave those who inquired a graphic report of the satisfaction which Standard air brakes had given in the distant colony in which he resides. Great credit is due to Mr. Wessels for his untiring energy, which has not only kept his company at the head of the street railway air brake industry, but has led to the building of a large and constantly increasing business.

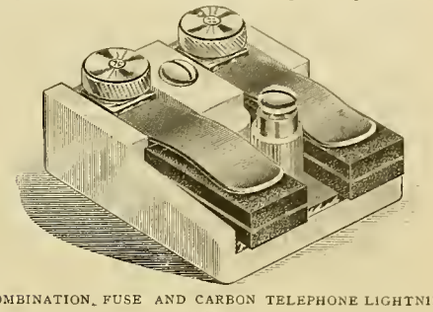
A notable exhibit was that of the Walker company of Cleveland, whose attractive booth with its fine examples of electrical railway machinery, kept scores of interested spectators before it. All the devices were handsomely designed and finished and made a most attractive spectacle, even to the uninitiated. The feature of the exhibit was the 400 horse power elevated railway truck, which furnished an example, perhaps never before equaled in mechanical

traction, of concentration of great power in small space. It consisted of a McGuire truck fitted with two No. 25 Walker elevated railway motors of 200 horse power each. It was especialy designed for the extremely heavy work to be met with in elevated railway traction and was capable of accelerating a three-car train to a speed of 25 miles per hour in 18 seconds. The motor was open to allow ample ventilation, while the bearings were self-oiling and so arranged that all waste oil was thrown back into the oil wells. A double 4 A equipment, consisting of two 30 horse power Walker motors, was shown on a Peckham truck, and with the electric brake controller formed an example of the Walker company's standard equipment for street railway work. The controller (type J 2) had been designed to meet the demand for quickly applied braking without the disadvantage of clogging the truck of the car with special gearing. While it accomplished this thoroughly the controller was very simple. To apply the brake the reverse handle was turned to the approprate notch, opening the trolley circuit and converting the motors into generators, the current developed being absorbed in a rheostat and the pull of the fields on the armature producing the necessary braking. The contacts were arranged so that it could be used either as a gradually applied brake for ordinary stops or as one instantaneously applied, in case of emergency. In addition to these two trucks a third was show designed for interurban service. This truck, a Dorner & Dutton, was fitted with two 50 horse power motors and comprised, with the controllers shown, the Walker 10-S double equipment. The motors in this and the 4-A equipment were spring-suspended after the Walker method. Controllers for all the standard equipments were shown, from the single motor controller to that for the double 50 horse power equipment. An excellent idea of the Walker motor construction was obtained from the handsome single motors and parts, noticeably an example of a 2-N-20 horse power motor designed for narrow-gauge work—120 of these motors have been sold in a single order to the Oberschlisische Dampfstrassenbahn (the Upper Silesia steam street railway) in Prussia, a steam road "electrified" where the track gauge is only 31 inches. The 150 kilowatt Walker street railway generator afforded a good example of modern generator construction. It was of 500 volts winding and had eight poles. Its protected back, ventilated armature and neatly wound field coils, protected with rope, were a few of its points of excellence. The brushes were held at a fixed angle with the commutator, yet the arrangement admitted of the removal or replacing of a brush while the machine was in operation without risk to attendant or without loosening any screws or clamps. The 25 kilowatt generator on the right of the booth showed the smallest dynamo manufactured by the Walker company. It weighed 4,200 pounds and was capable of a continued output of 240 amperes at 125 volts, its speed being 300 revolutions per minute. At the back of the booth was shown a large switchboard, built for the Tamaqua and Lansford railway. This was arranged for two 225 kilowatt railway generators and had four feeder circuits. The board consisted of four white marble panels mounted on an iron frame. Upon one panel were mounted the generator circuit breakers, ammeters, switches, lightning aresters and rheostats; on another the main ammeter, a recording wattmeter and a recording voltmeter, all showing the total output of the station, and on the other two the circuit breakers, ammeters, switches and lightning arresters for the various circuits. Particular attention was given to making all the connections on the back of the board in the simplest manner possible, and all contacts and connections were designed to carry double the normal load without appreciable heating. A solenoid blow-out controller showed the company's latest type of street railway controller, and it was pronounced the embodiment of all the Walker patents. To cut out a motor in case one becomes disabled it was shown that it was not necessary to open the controller and pry out a plug which might be rusted into place from disuse. There were six positions appropriately marked, for the reverse lever, instead of merely the usual "forward" and "reverse," as follows: Both motors ahead; No. 1 motor ahead, No. 2 motor cut out; No. 2 motor ahead, No. 1 motor cut out; both motors back; No. 1 motor back, No. 2 motor cut out; No. 2 back, No. 1 motor cut out. The operation of cutting out the motors was as simple as reversing the car. There were five running positions of the controller, arranged for uniform graduations of speed, the rheostat being so proportioned that the car could be run any length of time on any notch. The reverse cylinder was secured by a magnetic locking device which made it impossible to move the reverse when current was flowing through the controller. The solenoid blow-outs were embodied in the partition between the controller fingers. This prevented them from injury by the arc. A marked advantage of this arrangement was that the absence of conducting core rendered it impossible for a ground to develop in the solenoid circuit.

The General Electric company made the most extensive exhibit at Convention Hall, confining it, however, to motors, controllers, meters and subsidiary apparatus. It occupied the southwest corner of the main hall, and, brilliantly illuminated, formed a center of attraction for the entire fraternity. The motor exhibit comprised examples of the latest type "G E" 51, 52, 53, 55 and 57. The "G E 55" of 175 horse power capacity attracted much attention. This was not mounted. The others were all shown in motion mounted upon trucks. One McGuire pivotal truck was equipped with a "G E 51" 80 horse power motor on one axle, and an electric brake on the other, both controlled by a B 7 controller. Another truck of similar make and type carried on one axle a "G E 53" 50 horse power motor of special build for narrow-gauge work, and an electric brake. A Brill No. 27 truck was equipped with two "G E 57" 50 horse power motors, with an electric brake on each axle. This is the equipment used in the high-speed work on the Cleveland and Lorain road. To accommodate both motor and brake on the same axle the wheels are dished. The equipment was controlled by a B 8 controller. A Diamond truck also carried two "G E 57" motors, without brake equipment. On a Peckam flexible cantilever truck were mounted two "G E 52" 27 horse power motors with K 10 controller. All these equipments were arranged to show the operation of both motion and brakes. The equipments of the two McGuire trucks were controlled by one controller and were run either singly or both together. On each of the above equipments was set a Thomson recording car meter for use on the car itself, serving to show how a check may be placed on the performances of motormen with the controller. In the exhibit of the Barney and Smith Car company two "G E 1000" motors were mounted upon a pair of class H trucks. In the Peckham Truck and Wheel company's exhibit two "G E 52" motors were mounted on a cantilever street-car truck. The Duplex company's car running on the city tracks was also equipped throughout with General Electric apparatus, consisting of a double "G E 1000" equipment, B 13 controllers and electric brakes. Armature construction was exemplified by two completed "G E 52" armatures, a full set of motor mica insulations, a series of armature coils ready for application to the core, and a number of field coils. There were also several complete sets of motor commutators bound and headed for shipment. The gear work was well represented, all gears and pinions shown coming from the gear plant of the General Electric company. Three boards were erected in the space. The first was devoted to circuit breakers of the K, L, Q and M types, with magnetic blow-out, each of which could be shown in operation by means of a special switch, currents up to 200 amperes being ruptured. Upon the second was mounted an extensive line of instruments used in street railway and general work. These comprised the new electrostatic ground detector, Thomson inclined coil instruments of the portable and switchboard types, Thomson arc ammeter, astatic ammeter, G 2 astatic recording wattmeter for station output measurements, portable indicating wattmeters and pocket ammeters and voltmeters. This board was surmounted by one of the new "G E" edgewise ammeters. The third board was equipped with M. D. magnetic blow-out lightning arresters, both open and closed. These were shown in operation, the equivalent of the lightning flash being obtained from a Thomson X-ray inductorium, the flash being followed by current from the 500 volt circuit. This exhibit attracted considerable attention from the railroad men, to whom its operation was fully explained by H. C. Wirt. They were enabled to appreciate the method by means of which lightning discharges on lines are safely handled. To exemplify the action when an accident should cause a high-potential wire to fall across trolley wires with one end grounded, a voltmeter was used. The pressure being brought up to 2,000 volts, the arrester came into action, showing that the current, instead of passing through the apparatus, would take its path through the arresters. The exhibition space was illuminated by a number of enclosed 100-hour arc lamps for use on railway circuits. In front was an ornamental cornice carrying colored incandescent lamps. Above and behind it was a large sign with the company's name, and on the wall another giving succinctly the railway record of the General Electric company, viz., 2,173 generators, aggregating 512,213 horse power, 46,191 motors, aggregating 1,059,060 horse power, and 4,000 series parallel controllers. The headquarters of the General Electric company were in the writing room of the International Hotel. Here it had erected a small booth, in which an X-ray exhibition was given continuously. The new screen first used on this occasion is fixed, 12 inches square, and platino-cyanide of barium is used instead of the ordinary fluorescing salt. The walls of the writing room were hung with neatly framed diplomas, and with these a large volume on the table made an excellent showing of the General Electric company's prominence and pre-eminence at great expositions. For the first time a large number of the medals awarded to it were also shown. The social side was not neglected by the General Electric company. On Tuesday it arranged an enjoyable tally-ho and carriage party over to Canada. This courtesy was taken advantage of by nearly every lady at the convention. Parlor D was the company's social annex, which after about 9 p. m. seemed a remarkable center of attraction for everyone.

Combination Fuse and Carbon Telephone Lightning Arrester.

The accompanying cut illustrates a device now being pushed by the American Electric Telephone company of Chicago for the purpose of insuring greater safety in telephone exchanges from lightning and sneak currents. The arrangement consists essentially of a fuse block and an American carbon lightning arrester. The latter portion of the combination, the company states, is constructed in accordance with principles practically and theoretically correct. It is said to more perfectly serve the



COMBINATION FUSE AND CARBON TELEPHONE LIGHTNING ARRESTER.

purpose of an arrester than any other device on the market. This purpose is the protection from burn-outs by lightning of telephones and switchboards.

The cut is an enlarged view of the simple carbon arrester that accompanies every fuse in the line.

Rubber Products for the Engine Room.

At the recent convention of the National Association of Stationary Engineers in Columbus, the Peerless Rubber Manufacturing company of New York occupied a store opening into the main lobby of the hotel, and exhibited a full line of its engineering goods, particularly Eclipse sectional Rainbow gaskets, Rainbow sheet packing, Honest John hydraulic and Hercules packings. It also exhibited combination stop valve packing and Peerless piston packing. The Rainbow gauge glass rings, Anaconda steam hose for use in blowing out tubes, belting, hose, rubber valves, etc., received particular attention from the delegates. The company's Rain-Besto gaskets for very high pressure, being cut with metallic insertions, received especial attention. The exhibit was handsomely prepared and the goods made a fine showing. Hudson Dickerman of New York

RUBBER PRODUCTS FOR THE ENGINE ROOM.

was in charge of the exhibit, W. J. Courtney being also in attendance. They presented the ladies with handsome bouquets on the night of the reception and entertained the delegates with true hospitality.

Street Railway Matters in St. Paul.

President Lowry of the street railway company has refused to accept the ordinance which the council of St. Paul recently passed, directing the company to change the Selby avenue cable to an electric line. The council, to even things up, has under consideration the passage of a resolution directing the company to proceed at once to pave between its tracks. Mr. Lowry gives at length, in a letter to the council, his reasons for not agreeing to the ordinance. He claims that the time given for the change is insufficient; that the ordinance limits the electric franchise to 42 years; that the cable system is bonded and bondholders will not consent to the ordinance; that the ordinance requires an extended service to Prior avenue, where the company hopes soon to make another interurban line; that the transfer system required would be inconvenient and unprofitable.

Surface-contact Street Railway System.

On the occasion of the recent visit of Lord Kelvin to the works of the General Electric company in Schenectady the new surface-contact system of electric traction developed by that company was given a public and successful demonstration, after several months' experiment in private. Some account of this interesting system has been given, but the company now sends out a more complete description, with the statement that in a European city the first practical surface-contact electric railway is already far advanced toward completion.

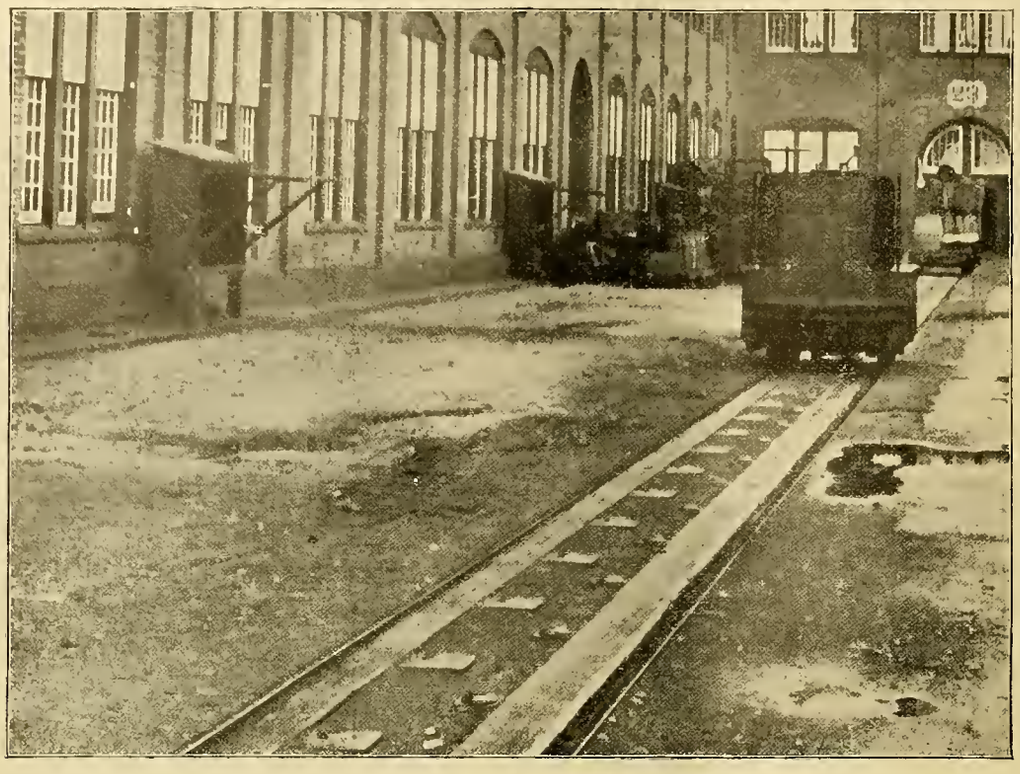


FIG. 1. SURFACE-CONTACT STREET RAILWAY SYSTEM.—STRETCH OF TRACK IN YARDS OF GENERAL ELECTRIC COMPANY'S WORKS AT SCHENECTADY, N. Y.

STAR SOLDERING STICK.

The experiments at Schenectady have been carried out upon a stretch of the track which forms part of the extensive factory tramway system of the General Electric company's works. As the illustration (Fig. 1) shows, the addition to the roadbed between the rails of the track consists simply in two parallel rows of iron disks, convexed to a height of about one inch above the level of the rail. The car shown in the illustration is a simple factory tramway to which the controller, motor and storage battery equipment have been fitted. It may be said here that the General Electric company is now engaged in changing over to the surface-contact system the entire trolley tramway system in its yards.

The main requirements in a surface-contact system are four: Low cost of installation and maintenance; absolute absence of current from all disks not covered by the car; freedom from leakage of current, and reliability under all possible conditions of weather, service and location. It is the attempt to meet simultaneously all these requirements that has rendered the problem one of considerable difficulty, demanding long study and costly experiment to overcome. In the General Electric surface-contact system, it is claimed that the requirements are adequately complied with.

The only live portions of the system on the street surface are the contact plates immediately beneath the car. This is true whatever the position of the car and whatever the speed—each plate in turn communicating current to the motors and becoming inert as the contact shoe on the car leaves its surface. These contact plates are placed in parallel rows between the two rails of the track and are set alternately. In the illustration the positive or communicating disks are on the right, the negative or discharging disks are on the left, one of each between two of the others. Each positive contact plate is made alive by the operation of an automatic magnetic switch, which, instead of being placed in immediate juxtaposition with its plate or opposite it outside the track, is placed in a manhole with a large number of others, each connected to its own respective plate. Through each negative plate is performed the double duty of closing the contact in the switch, which "cuts in" the positive plate and of receiving the return current from the motors. Fig. 2 shows the arrangement of the plates on the street surface.

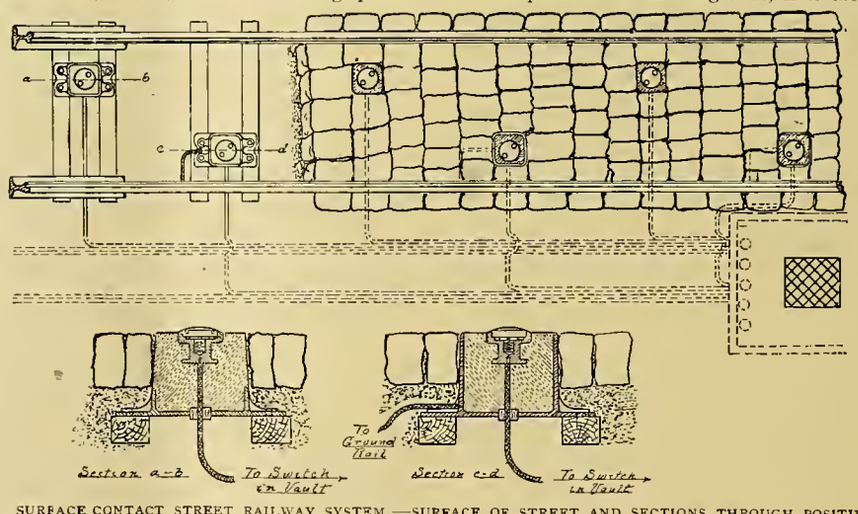


FIG. 2. SURFACE CONTACT STREET RAILWAY SYSTEM.—SURFACE OF STREET AND SECTIONS THROUGH POSITIVE AND NEGATIVE PLATES.

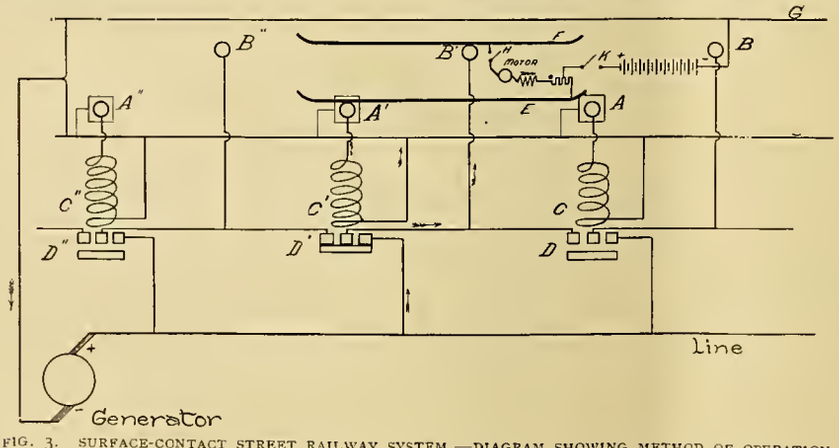


FIG. 3. SURFACE-CONTACT STREET RAILWAY SYSTEM.—DIAGRAM SHOWING METHOD OF OPERATION.

The operation of this system will be understood from the diagram (Fig. 3). A, A' and A" are the negative plates and B, B' and B" the positive contact plates, placed equal distances apart, a little less than one-half the over-all length of the shoe. C, C', C", represent the automatic magnetic switches and D, D' and D" their armature or contact makers. F is the positive or collecting shoe, E is the negative or return shoe and G the track return. H and K are switches which form part of the controller, the latter connecting in or cutting out the cells of a small storage battery, which is used only to energize the coil of the first switch through the plate over which the car passes in starting. After the armature of the first switch has been raised into contact and the line current has completed its circuit, the battery is cut out by the forward movement of the controller handle. In the diagram the car is to move to the right and all the magnetic switches are open. The handle of the controller is turned to the first notch and switches H and K are closed. Current from the battery flows through a small portion of the motor resistance to the shoe, thence to contact plate A' and the coil C', completing the circuit to the ground. The coil C', thus energized, raises the armature D', closes the circuit through the automatic switch, and the line circuit completes its path through the motors and through the greater part of the motor-starting resistance shown by the arrows through the positive plate B and shoe F. Part of the return circuit goes to the storage cells, which are kept constantly charged, and part through shoe E, negative contact plate A' and coil C' to ground, keeping the latter energized and the automatic switch closed so long as the shoe remains on contact plate A'. Moving the controller handle forward from the first notch to the second notch opens the switch K, cuts out the battery and sends all the return current through the coil C'. The shoes E and F in the diagram are a little longer than the distance between contact plates. Thus when the car moves forward slightly, the shoe will be in contact with the two contact plates A and A'

and the return circuit will divide, half going through coil C' and half through coil C, energizing both, and closing the armatures in the switches D' and D. The car moves forward and the shoe passes beyond the contact plate A'. The circuit in the coil C' is broken, the armature D' drops, cutting out entirely positive plate B'', leaving it dead but allowing B' still to receive current through the closed switch at D. Shoe F moving forward then makes contact with plate B before it leaves plate B' and the current is uninterrupted in its flow.

The automatic magnetic switch is the heart of this system. It has been designed to endure under the severest strains and to act with such uninterrupted precision that the working of the system may not be impaired. The development of this automatic magnetic switch marks a decided step forward. Mechanically the switch is simple, strong and durable, with all chances of derangement reduced to a minimum. In the course of the experiments this switch has been subjected to the roughest possible usage and has withstood it unharmed.

If the leakage is great an arc is likely to form when the armature of the switch drops, and so long as this is held the contact plate on the street would remain alive, while the arc would burn the switch. It is not practicable to allow the armature to drop far enough to break the arc, and to extinguish it the magnetic blow-out principle is brought into play. By the use of this, retention of this arc is impossible. But there is also the possibility of another arc forming in case of accidental ground on one of the leads to the positive contact plate or if the forward switch fails to close when the handle of the controller is on the first notch, giving a path to ground through battery. This is also taken care of by the magnetic blow-out. All surface-contact systems have similar conditions to meet, but none have incorporated the magnetic blow-out principle.

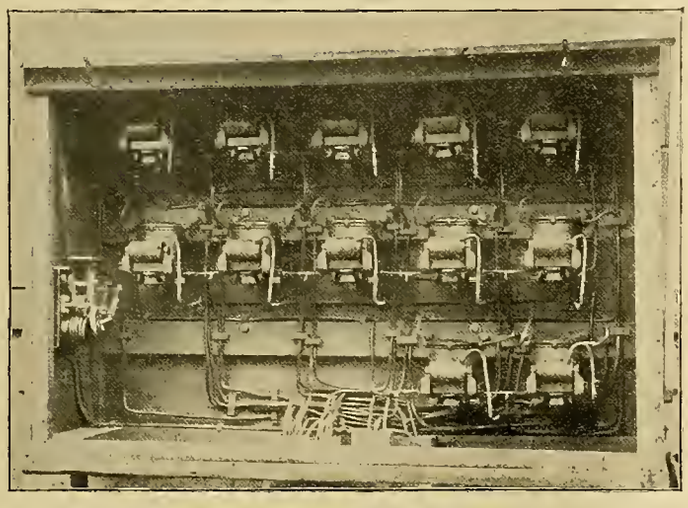


FIG. 4. SURFACE CONTACT STREET RAILWAY SYSTEM.—SHOWING AUTOMATIC MAGNETIC SWITCHES IN TEMPORARY MANHOLE.

The form of the contact plates is shown in Fig. 2. They are first set in iron boxes and then surrounded by insulation. The contact plates consist of two parts, a wearing piece screwed into a support and held by a spring washer. This wearing piece can be removed readily without disturbing the support. The standard shoe is 13 feet long. Its shape and suspension are shown in Fig. 5, the ends being curved upward slightly to prevent catching. The shoes are supported from the axles and have a slight upward and downward movement to allow for any irregularities in the height of the contact plates. The amount of drop in the shoe is regulated by a set-screw.

The automatic magnetic switches are grouped in manholes where inspection can readily be effected. Fig. 4 shows a group of these temporarily arranged for exhibition. Each manhole will contain about 20 switches, and the wires from the contact plates to them will be protected in similar manner to underground wires for any other purpose.

The battery on a car consists of 10 cells with normal capacity of 50 ampere-hours at five amperes. It is equal to all emergencies, being called into requisition only momentarily, while being charged the balance of the time the controller handle is on the first notch.

A close examination of the design and operation of this system will show that it possesses many advantages. The operation of the automatic switches is claimed to be perfect under all conditions, as the full line voltage can be secured to close them and they open by gravity. There is no possible chance of the contact remaining electrified after the car has passed, as by the use of the blow-out on the switch and the switch itself, which opens as soon as the current is shut off, all danger and trouble due to live contacts are eliminated.

Grouping the switches in manholes renders the working part of the system easily accessible for inspection.

In the city of Monte Carlo, in the principality of Monaco, this system is being laid down by the Cie. Française Thomson-Houston, over a distance of about three miles. It is expected that this line will be in operation soon.

Star Soldering Stick.

The Western Electric company is placing upon the market the soldering stick shown by the accompanying illustration. The stick is about six inches long and seven-eighths inch in diameter. It is composed of carefully prepared and pure chemicals which are non-corrosive and at the same time make a superior flux for soldering. The virtue of this stick is that it makes the solder stick to the wire and all well posted electricians understand how important it is that the solder should unite with the wire in making a joint. If there is a gap between the solder and the wire and the two metals do not amalgamate, there is a local action caused by the current of electricity which eventually will eat away the wire at the joint. It is for this reason that the underwriters have been so particular to specify that joints shall be well cleansed and soldered, knowing that a joint that is not cleansed could not be well soldered and would be a hazard from the fire insurance standpoint. For this reason the Western Electric company asserts that every wireman should carry in his grip a Star soldering stick.

How to Avoid Lightning.

[From the London Chronicle.]

The other day a gentleman who happened to be in the middle of a field was struck by lightning. Most people would have thought his position about the least dangerous in a thunderstorm. The point they have asked themselves, therefore, is, "What should we do when caught in a thunderstorm?"

Campbell Swinton says lightning is most apt to strike projecting objects—for example, a tree. On that principle you ought to keep clear of trees, just as you would keep clear of a hayrick. Similarly, if you are in a flat space, like a farmer's field, you should make yourself as little objective as possible. If everything about is level you yourself become the projective point which may attract the lightning. Therefore, lie down flat on the ground, or, even better, get into a hole.

"A person who took shelter in a hole," Campbell Swinton continued, "would be absolutely safe, I should think. Even if the lightning were to strike the ground near by, its power would scatter so much that he would hardly be likely to come to harm. Then, if you are in a house while a thunderstorm is raging, the safest shelter would be found in the cellar—that is, far away from the objective parts of the building. For myself, I am rather skeptical how many folks would care to crawl into a hole or plunge into a cellar. You see, the risk to life and limb in England from lightning is very small indeed—so small that the average man would run it rather than disturb himself."

"I suppose the idea which you have indicated to me explains the damage that factory chimneys and the chimneys of dwelling-houses occasionally sustain from lightning?"

"Just so; they are points of attraction. Not only that, but there must be an additional attraction in the column of warm air which rises from a chimney when a fire is burning beneath it. I once saw a chimney struck by lightning, and smoke had been issuing from it. There were various neighboring chimneys, but, so far as I could make out, none of them was active. The incident occurred while I was sitting in the Wellington Club, and the damaged chimney belonged to a house on the other side of Grosvenor crescent."

The St. Paul Board of Aldermen has adopted a resolution calling for bids for electric motors and generators, to supersede the batteries in the operation of the police patrol telegraph.

Municipal Ownership and Operation of Street Railways.[1]

By P. F. Sullivan

The subject of this paper is one which cannot be treated properly or in other than a limited manner within the time and space permitted. What I shall write, therefore, is intended more to suggest lines along which others may follow, rather than to attempt to treat it exhaustively.

The subject will be considered under the two following propositions:

Municipal administration in American cities is so extravagant and unbusinesslike, that in the interest of the public the powers and duties of municipalities should be reduced rather than enlarged.

Municipal ownership and operation abroad are the exception rather than the rule; and were the reverse true, and such ownership and operation successful from a financial point of view, it does not follow that American cities could or should follow such examples, or that if they did so, success would result.

As to whether we should experiment with socialism, particularly under our forms of municipal government, while still going through the experimental stage, and as to whether popular government should compete with private enterprises, I leave for other and separate discussion.

Thoughtful men view with alarm the growth of American cities and the maladministration of their affairs; some go so far as to believe that both conditions seriously threaten the future of the republic. So alarming have these become that patriotic and thoughtful men, and women, too, have organized in nearly every city in the country with a view of arousing public opinion, of devising ways and means to purify local politics, and to obtain a fair return for money expended.

In nearly every large city in every state in the Union, from Maine to California and from Oregon to Florida, such organizations exist under one name or another, and in some cities they go so far as to employ counsel and to instruct city governments in their duties. This is true of Boston, Providence, New York, Baltimore, New Orleans, Chicago, San Francisco and other cities. At the present time there are over 50 of such organizations in existence.

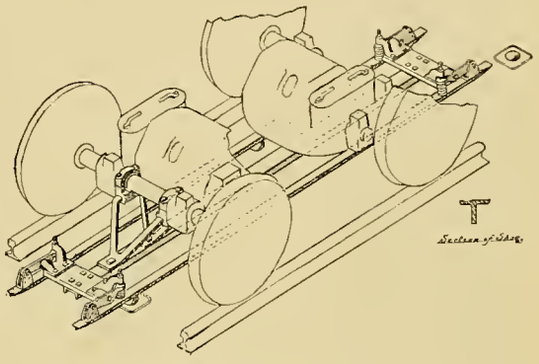


FIG. 5. SURFACE-CONTACT STREET RAILWAY SYSTEM.—SHOWING SHOES ON CAR TRACK.

Not only are there local organizations, but such organizations also send delegates to national conferences to adopt methods of arousing public opinion and purifying local politics in every city in the Union. Conferences for good city government were held at Philadelphia in 1894, at Minneapolis and Cleveland in 1895, at Baltimore in 1896, and at Louisville in 1897. To show how general and widespread are municipal maladministration and corruption throughout the country, I quote below extracts from the remarks of a few of the delegates.

[Here are given extracts from the views of Franklin MacVeagh of Chicago, Charles J. Bonaparte of Baltimore, Rev. Dr. Washington Gladden of Columbus, Edwin D. Mead of Boston, James C. Carter of New York and several others.]

Under the conditions disclosed by the foregoing extracts—extracts, too, from American citizens—is it not strange that men will be found who will advocate enlarging the opportunities and powers of our city governments? Surely no business man would advocate it. On the contrary, he would have our municipalities conduct the business in hand in the same manner as the same business could be conducted by private enterprise before he would approve enlarging their powers and opportunities.

But the theorist says, "Enlarge the responsibilities of the government, and you will improve it." Acting upon that theory the doors of every house of correction and penitentiary in the land should be opened and every evil-doer therein sent back to the community whence he came. He should then be restored to his former position in the community, and instead of looking after his conduct and affairs more closely, he should be given carte blanche to do as he may wish.

According to the returns of street and road tramways to Parliament, July, 1896, there were 153

1. Abstract of paper read before the American Street Railway association at Niagara Falls, October 19, 1897.

distinct street railway undertakings in Great Britain and Ireland, subdivided as follows:

Number of companies owned and operated by private capital	116
Number of undertakings where tracks are constructed by the municipalities and leased to private parties	31
Number of undertakings owned and operated by the municipalities	6
	153

Considering now the six cities where the tramways are operated by the municipalities, we note these statistics:

City.	Population.	Miles of Track.
Glasgow and suburbs	840,000	73
Leeds	400,000	27
Sheffield	380,000	19
Huddersfield	100,000	21
Plymouth	90,000	5
Blackpool	35,000	5
		150

Glasgow.—Of the above cities, Glasgow is the only one wherein the undertaking may fairly be called successful. And with reasonable economy it could not well be otherwise than financially successful. For a population of over 800,000 Glasgow has only 73 miles of tracks, whereas St. Louis, with a population of less than 700,000, has over 335 miles of tracks. It does not follow, therefore, that if the government of St. Louis was conducted equally as well as the government of Glasgow, that it could also operate the street railway system of that city successfully financially.

It is well to remember, however, that Glasgow boasts of a "continuity of existence of over nine centuries." We may therefore safely place it within the limits of possibility that when our American cities survive a "continuity of over nine centuries," that they may be so far advanced in methods and morals that they, too, may be intrusted with additional power and responsibilities.

Leeds.—The city of Leeds had operated its street-car system for nearly three years. The first year showed net earnings of approximately $15,000, less than one per cent. upon the capital invested, whereas private capital earned and paid seven per cent. the previous year. The second year showed net profit of $35,000, not quite the interest upon the sinking fund. And such results, too, with a population of nearly 15,000 per mile of track.

Sheffield.—Previous to the acquisition of the street railway by the municipality, July, 1896, private capital received from five to eight per cent. dividends from the operation of the property. Under municipal management there was a loss the first year, not even earning the interest upon the capital invested. And such results in a city which has over 17,000 persons per mile of track!

Huddersfield.—This is the first city in England to attempt the operation of its street railway, and for the 14 years which it has operated the property there is a loss of $311,000, varying from $3,300 to $83,000 in a single year. This loss has been met by drawing $105,000 from the depreciation account and the balance by taxation, varying from one-ninth of a penny to five pence per pound. It may seem strange that the municipality should thus continue to operate under such conditions. The fact is that Huddersfield is a manufacturing city and the non-property and small tax-paying voters are in a majority.

Plymouth.—In the last fiscal year there was a loss of $5,430. This city did not acquire the property voluntarily. On the contrary, the operating company intentionally forfeited its charter and abandoned the operation of cars.

Blackpool.—This operation shows a net profit for four years of $992 after paying interest and charging off to depreciation.

And yet in Plymouth, Huddersfield, Sheffield and other cities in England boys of from 14 to 16 years of age, receiving $2.50 per week, are employed as conductors. Notwithstanding such conditions, some of those cities have not earned the interest upon the capital invested. Does anyone suppose that American cities if operating street railways could employ such conductors at such rate of wages?

In Germany there are only three cities which own and operate their street railway systems, and two which own the tracks and lease them to operating companies. In France there are none.

The facts as they are before us are, that there are few cities abroad which own and operate their street railway systems with more or less indifferent results, and only one of which, viz., Glasgow, which can properly be called a financial success; and yet there are those who would have American cities, regardless of differences of conditions and institutions, plunge blindly into the acquisition and operation of 15,000 miles of street railway tracks because Glasgow operates 73 miles successfully.

It seems to me that those who honestly advocate the acquisition and operation of street railways by municipalities do not look below the surface. They find that an occasional city abroad does such things and they immediately jump to the conclusion that we should do likewise. They do not study the conditions with respect to accommodations furnished abroad as compared with those in this country; the methods of administration there compared with those here, and the civil service abroad compared with ours.

In a previous paragraph I showed the difference between St. Louis and Glasgow. Below will be found a comparison of other cities of nearly the same population, taken from the Yale Review for May, 1897.

City.	Population.	Area in Sq. Miles.	Street Railway Mileage.	Mileage per 1,000 of Population.	Mileage per Sq. Mile of Area.
Birmingham	497,000	20	33	.066	1.65
Boston	494,000	37	295	.597	8.00
Edinburgh	289,000	14	21	.072	1.50
Detroit	300,000	28	202	.673	7.21
Leeds	400,000	34	27	.067	0.79
Cleveland	350,000	32	205	.585	6.40
Liverpool	641,000	21	66	.103	3.14
St. Louis	644 000	62	216	.320	3.50
Manchester	530,000	20	54	.102	2.70
Baltimore	512,000	34	262	.511	7.70
Bradford	228,000	17	21	.091	1.23
New Orleans	250,000	40	169	.676	4 22
London	4,400,000	105	230	.052	2.19
New York	1,851,000	59	357	.203	6.05

Compare any one of the above foreign cities with an American city of the same population and you will find that the area of the latter is greater and the street railway accommodations greater in proportion than the former. The English cities average over 15,000 persons and the American cities over 2,600 per mile of track. And yet there are those who would state that because Leeds could operate 27 miles of track successfully that Cleveland, with nearly the same population and area, could also operate 205 miles of track, nearly nine times as many miles of track, also successfully. If, therefore, the methods of civil service and administration were the same in both cities, Leeds could be eminently successful and Cleveland a monumental failure.

[Long quotations are given from authors who point out the lax conduct of the public works of American cities and, in general, the crude methods of municipal government.]

The experience of France and Brazil with government ownership of railroads is not encouraging to the advocates of the idea that railroads should belong to the people at large, and should be operated by officers appointed by the government. The South American republic has determined to abandon state ownership of railroads, after a thorough test of the theory, and is now negotiating with European capitalists for a lease of the entire system, comprising 14,000 miles of track. When Brazil took charge of the Central railroad, that corporation had paid as high as nine per cent. dividends, but under government control it has not only failed to earn its expenses but has cost the people $2,000,000 or $3,000,000 a year above its receipts.

The experiment of state ownership of railroads has been tried longer in France than in Brazil, and under more favorable conditions. The model road there runs through well populated districts, with large cities as terminals, but the results in France are discouraging. Eighteen years ago a railroad system was constructed, which was to furnish cheap rates for passengers, cheap freight for shippers, and abundant profit for the state. It has done none of these things. At first the advocates of the enterprise insisted that only time was required to prove the wisdom of this project. Eighteen years have passed and the results may be briefly summarized. Theoretic methods have been abandoned, and the railroad is now managed substantially as are those in the hands of private capitalists, except its tariff of rates is a little higher and its cost of operation is considerably larger. The last report shows that the net return on the whole capital expended is 1.35 per cent., and even the state cannot borrow money for less than three per cent. The government has every year a considerable deficiency to settle, and the people who use the line pay somewhat more than they would have done if the enterprise had been left to private capital.

Canada has had an experience of state ownership also, but upon a more limited extent. There the government owns about 10 per cent. of the whole, upon which it loses about $500,000 annually.

The railroads and their equipments and fares of France and Germany operated by the government cannot be compared with those of England operated by private capital; and the manufacture of tobacco and cigars by the government of France has produced such vile stuff as to be an object lesson to enthusiasts of government monopoly.

Some of the advocates of changing the present state of things stop short at the operation of street railways by the municipalities, and advocate that the municipalities own the tracks and lease them to private capital. They are aware of the present condition of our administrations and dare not go the logical length of their position. If our municipalities are so unbusinesslike and corrupt in their methods as to be incapable of operating a street railway property, then they are also unfit to manage the construction of the property and to make contracts for its use. You cannot stop half way.

The motive for public ownership abroad is twofold. The first has reference to the conditions of the streets and street surface. They have, as a rule, finely constructed and maintained streets, and in their very proper regard for keeping them so, they desire to control all construction and maintenance of tracks. The second has reference to controlling and regulating the method of operation. That has proven a failure, and can be accomplished better when granting a franchise. In nearly every case in England where the municipality acquired the operation of the property it did so involuntarily.

The city of Toronto, Canada, is the only instance in this country of public ownership and private operation. The conditions and contract there please the theorists and the street railway company, and all are happy. While I am neither a prophet nor the son of one, I will state that, in my opinion, before the contract period shall have expired, Toronto will have cause to regret that it adopted some English methods under almost American conditions. The municipality constructs the concrete bed for the tracks, supplies and does all paving, and removes all plowed snow. The compensation which it receives per mile of track is much less than that paid in some states by one company for running over the tracks of another company. Percentage of receipts, rates of fare, etc., should be looked upon as nothing more nor less than a premium for which the operating company receives a monopoly. Competition and the fear of it are completely shut out. Single fare and transfer carry a passenger only to the suburbs. Those going to and from the suburbs pay extra fares, and as the city grows in population, it will become as congested as foreign cities, or the people will be compelled to pay extra fares to get to and from suburban homes. Such conditions exist nowhere in the United States.

The conditions with respect to Toronto and its suburbs suggest a practical problem in the United States should municipalities desire to acquire street railway properties. Street railway systems abroad are usually operated within the limits of the municipality, as at Toronto. Should the systems be extended further additional fares are charged. In the United States, on the contrary, in nearly every instance the street railway system extends beyond the city or town limits, and usually only a single fare is charged. Should a city obtain the street railway system within its own jurisdiction, an interesting problem is opened with respect to the owner of the balance of the property; and in case the balance of the property should be acquired by the other towns through which the system may be operated, as to divisions of "spoils," profits and losses. It may result, as it did in Birmingham, England, in the price of gas. That city provides its own gas and charges suburban towns 50 per cent. more than it charges its city consumers.

MUNICIPAL OWNERSHIP.

Street Railways Abroad.

[From the Chicago Times Herald.]

One would think, to read Professor Frank Parsons' series of articles in the New Time that nearly all of the street railways in Europe were operated by municipalities. But this is not true. Municipal ownership is the exception, not the rule.

In his admirable article in Municipal Affairs for September, E. E. Higgins presents figures which show to what a limited extent municipal operation prevails. In Canada there is but one example, found in Port Arthur, a town of 2,700 inhabitants, which owns an eight-mile line, on which four cars are operated. There are but four instances in Germany, and these are among the smaller towns, the big cities like Berlin and Hamburg being served by private companies. In Switzerland there are but three cases of operation by cantons. Great Britain has but six municipal lines, against about 125 privately controlled, and two of the former are on an extremely small scale. There is nothing of the kind in France, Austria, Hungary, Belgium, Italy, Russia, Spain and Holland. In all the world but 14 cities and towns have assumed the responsibility of operating their street railways.

The single example of successful municipal operation is that of Glasgow, and of this the socialists make much. Mr. Higgins has taken the pains to compare the Glasgow tramways with those of Brooklyn and Boston, the two American cities most nearly approximating the Scotch metropolis in size. Glasgow has the advantage of a density of population of 20,000 per square mile, against Boston's density of 5,700 per square mile. Boston has five times as many miles of line, while Brooklyn has seven times as many. In Glasgow the average fare paid is 1.85 cents per mile, but the fares are based upon the length of distance traveled, and the average distance traveled per passenger in Glasgow is only one mile. One may ride 18 miles in Brooklyn for five cents, and Mr. Higgins regards it as certain that street railway transportation rates per mile traveled are, in both American cities, much lower than in Glasgow.

Socialists always talk of profits to municipalities. They argue as if the diversion of revenues from the people to the state were the greatest desideratum of modern civilization. But, granting their contention, Mr. Higgins disposes of their last argument. He shows conclusively that during its last financial year the West End Street Railway company of Boston paid into the public treasury in the form of taxes a sum greater by 28 per cent. than the entire operating profits of the Glasgow municipal system during its last financial year; and the street railway properties of Brooklyn paid as taxes twice over as much as the Glasgow operating profits.

Glasgow's Municipal Service.

[From the London Electrical Review.]

The treasury inquiry into the question of the municipalization of telephones which was opened on Tuesday last at Glasgow will, no doubt, be followed with the greatest interest, not only by telephone men and the electrical profession generally, but by those interested in the widening of municipal operations. One has often been told, by Scotch papers, that the municipal government of Glasgow is the best in the world, and, no doubt, much has been done to ameliorate the conditions of those who are compelled to live in Glasgow. Should it come to pass, however, that a Glasgow municipal telephone system became an established fact, we trust its attainment may be accomplished without indulging in that penchant for conducting inquiries in foreign lands that is a distinguishing characteristic of Glasgow committees, and it would be a matter for profound regret if any dispute were to arise as to the proper committee to supply the electrical current necessary to work the telephone system.

Although Glasgow may consider itself in many respects the center of light and leading, it has by no means made astonishing progress in municipal electrical work. The population of Glasgow is 657,000, and the ratable value £4,046,726; Manchester, on the other hand, has a population of 530,000, and a ratable value of £2,911,083. Curiously enough, the municipal control of electric lighting commenced in the two cities within a few months of each other, but the latest returns show a marked difference in the two systems, as will be seen from the following figures:

	35 watts lamps.	Units sold.	Revenue.
Manchester	123,595	1,748,244	£38,253
Glasgow	79,140	1,090,959	£25,868

For years past the Glasgow corporation has owned probably the most paying system of tramways in the kingdom, and four or five years ago a committee collected an amazing mass of information on the subject of working tramways by electrical means; moreover, it was generally accepted that electrical working was far and away the best system. Four years ago the tramways in Leeds were owned and worked by a company, yet to-day the corporation of Leeds has not only taken over the whole of the city tramways, but has equipped 10 miles with the overhead trolley system—and Glasgow to-day is in a difficulty about running a short experimental line on the same system. Notwithstanding, Glasgow has sufficient confidence in itself to be desirous of acquiring and working a telephone system.

Mr. Dooley's Views on the Subject.

[Reported by F. P. Dunne in the Chicago Evening Post.]

"What we need in this counthry," said Mr. Dooley, "is muny-cipyal ownership."

"Oh, aye," said Mr. Hennessy in a puzzled tone.

"What we need," said Mr. Dooley, "is muny-cipyal ownership."

"Sure," said Mr. Hennessy. "What is it?"

"Here's a paper about it," said Mr. Dooley. "I got it off a man that was in here that'd just been discha-arged be Yerkuss f'r stoppin' at a sthreet corner f'r passengers. He give it to me. He's in favor iv it.

"Ye see 'tis this way. Th' city is goin' to own th' sthreet railroads an' th' gashouses an' th' ilicthric lightin' plants an' all. Th' city'll own thim an' r-run thim f'r th' binifit iv th' people an' a ma-an instead iv payin' a nickel f'r ridin' in th' sthreet ca-ar to a la-ad he niver see before, will thransfer th' coin fr'm wan pocket to another an' ring up wan fare f'r himsilf.

"'Twill make things good in politics again. Since th' clan wint to pieces an' me Boolgahrian frind Misther Kraus come into his job, politics has been so quite an' simple in th' Sixth wa-ard that anny German cud undherstand thim. But whin we have muny-cipyal ownership 'twill be diff'rent. Willum J. O'Brien will be prisident iv th' sthreet ca-ar company, if he don't acquire it be degrees be that time, an' me frind little Jawnny Powers 'll r-run th' gashouses. They'll meet together th' night before th' prim'ries. 'Is Casey with us?' says Powers 'I'm afraid not,' says O'Brien. 'I heerd him call f'r McInerney to sing "Gawd Save Ireland" at th' picnic.' 'I'll cut off his gas to-morrow, an' do ye see that he walks downtown f'r th' rist iv his nachural life,' says Powers. 'How is Adofski, th' Polish man?'

"'He's thrue as steel,' says O'Brien. 'Him an' his tin thousan' Polackers is with us to a man.' 'Give him a season pass an' I'll se that his meter is turned back a few thousan' feet,' says Powers. 'He's a good man. Is his brother wur-rkin'?' 'I spoke to Coughlin las' week f'r to make him superintindent iv th' tiliphone comp'ny, but he had a man f'r th' place—th' big fellow named Smith that done up Sandy Walters.' 'That's jist like Coughlin,' says Powers. 'He's a perfec' hog. Didn't we lave him put Jawnny Sterchie in as threeasurer iv th' clearin'-house las' year? Ye'd betther see Brennan an' ask him if can't make Adofski's brother his sicrity in th' ilicthric light wur-ruks. He's a good man. He can't read or write.' 'I'll do it,' says O'Brien. 'Ar-re th' boys r-ready f'r to-morrow?' 'They ar-re,' says Powers. 'All r-ready. We'll have five thousan' in th' war-ard and wan thousan' to go over in thrucks to th' twinty-ninth whin McInerney goes f'r to vote th' employees iv th' Town iv Lake lines. He's goin' to stop th' cars all day. Don't ye think we'd betther do th' same?' 'No,' says O'Brien. 'If we don't have some ca-ars r-runnin' how can we get th' boys fr'm wan prim'ry to th' other?' 'Willyum, ye'er a janius,' says Powers. 'But how about th' gas wur-ruks?' 'Shut thim down,' says O'Brien. 'Our fellows can wurruk a dale betther in th' dark.' 'So they can, so they can. I'll go to th' saloon now an' declare an exthra dividend. We'll need ivery cint to-morrah. I hear McInerney is givin' gas away free f'r this week.' 'Th' ma-an's foolish,' says O'Brien. 'Th' day afther th' prim'ry I'm goin' to ask ye to call a meetin' iv th' directors to raise th' price to $5 a thousan'.' 'I'm afraid we can't get a quorum,' says Powers. 'Manny iv th' la-ads is out iv town. Spike Hinnessy is off with his sthring iv horses an' th' big Swede has been exthradited to New York f'r blowin' a safe. Thin Carlson is out throwin' th' shells afther a circus, an' on'y you an' me an' Brenner is left iv th' whole boord.' 'Well thin, we'll have to pump in a little air,' says O'Brien. 'We've got to get square somehow.' 'The people'll kick,' says Powers. 'Iv coorse they will,' says O'Brien. 'They kick about iverything. Oh, 'tis a thankless task to sarve th' public. Tin iv th' best years iv me life have I spint in their intherests. an' I'm growin' tired. I've half a mind to take what there's left in th' dhrawer an' lave this ongrateful counthry.' An' thin they'll go away together.

"Oh, 'twill be a great thing f'r th' city whin it gets goin'."

"It'll niver get goin'," said Mr. Hennessy.

"An' why not?" said Mr. Dooley.

"Because th' la-ads that has hold now have a grip ye cudden't break with an ice pick."

"Perhaps ye-er right," said Mr. Dooley. "An' I don't know but what I'd as soon have Powers an' O'Brien as thim we do have. It's on'y a question iv who does th' robbin'. Th' diff'rence is between pickin' pockets an' usin' a lead pipe."

Philadelphia's Gas Plant.

[From the Chicago Record.]

The Philadelphia experiment does indeed prove that municipal ownership is not a cure-all for every ill, and that it should not be entered upon regardless of conditions. It should be set down as fundamental that municipal operation cannot succeed and ought not to be undertaken with the spoils system in vogue. It is folly amounting almost to a crime for anyone to advocate municipal ownership and operation who is not willing first to see a thorough-going civil service system in vogue. Therein is the inconsistency of some of Chicago's labor leaders, who advocate municipal ownership and operation while fighting the merit system. Philadelphia undertook to operate a municipal gas-plant with the spoils system in vogue and the city in control of a vicious political machine. Naturally the gas-plant, like every other department of the public service, was used to perpetuate the power of the ring. Under such circumstances, of course, a municipal gas-plant could not be a success, especially when the influences of the franchise-holding interests of the country were exercised to make of it as much of a failure as possible. It must be remembered, however, that the gas-plant under municipal control was not the only institution of which Philadelphia has had cause to complain. Other industries of a public nature under private control have also been powerful forces working for misgovernment and machine rule in that city, just as they are in Chicago and other American municipalities.

The Philadelphia experiment proves just what everybody of ordinary sense knows, that municipal operation under the spoils system is bound to be a failure. And, for that matter, all government must prove a failure under the spoils system. The Philadelphia experiment proves nothing more than this, and the effort to make it appear that it settles conclusively the question under discussion is false and misleading. The argument to this effect would only be put forth by those with a predisposition in favor of private management. As to whether or not municipal ownership and operation would be successful with the merit system in operation is another question entirely.

Failure of City Gas Plant in Philadelphia.

[From the Philadelphia North American.]

The gas supplied to the city of Philadelphia is very bad, and it is so owing to a variety of reasons which it is not in the power of the municipal government to amend. Chief among these reasons is the condition of the plant. It is partly worn out, wholly out of date, and radically inefficient. Over a large part of the city the service pipes are too small for the work required of them, and to a great extent they are so rotten that a very considerable percentage of the gas which they convey is lost through leakage. To replace these pipes and to construct a new plant, enlarged to meet the necessities of an enlarged community, and provided with the modern appliances of manufacture and distribution, would require the immediate expenditure of not less than $5,000,000. This money the city does not possess, as applicable to this purpose, and has no means of obtaining. This is one argument in favor of the lease, and it is an unanswerable one.

Another thing. Perhaps most people have an idea that the operation of the gas-works is a source of considerable revenue to the municipality. This is a mistake. As a matter of fact, the works are run at a loss. In 1896 the receipts from all sources of the Bureau of Gas were $3,318,145, and the expenditures, $3,552,103, showing a deficit of $234,958; and it should be noted that in arriving at these figures no allowance is made for interest upon the investment or for the deterioration of the plant, items which always enter into the business man's calculations when he is striking a profit-and-loss balance. It is true that upon the whole the chief of the Bureau of Gas is able to figure out an apparent profit of $352,988, but this is done by including the profit on $700,000 worth of gas purchased from the Philadelphia Gas Improvement company at 37 cents a thousand, and sold to the public at a dollar. Upon the gas manufactured by the city the loss is constant and considerable, and even the profit reported is illusory, because in arriving at it no account is taken of the interest on the investment or of the depreciation of the plant. It is said that there is no reason why the city should not conduct the works as economically and efficiently as a private corporation. Perhaps not, in theory, but there is in practice; and it is an insurmountable one. The reason is that it is impossible to keep politics out of the gas-works so long as they are operated as a department of the city government, and the result of this is a substantial increase in the cost and decrease in the efficiency of their administration.

A late dispatch from Philadelphia states that the resolution recently passed by the Select Council to submit the question of leasing the city gas-works to a private corporation was defeated in Common Council. The vote was 54 for the resolution and 64 against. There were few absentees. A joint sub-committee on finance and gas has been considering various propositions to lease the city works for 30 years, and referred them all to the general joint committee, recommending only that submitted by the United Gas Improvement company. It was after this step that the Select Council resolution prevailed. The defeat of that resolution prevents the people from voting on the question.

Value of Franchises.

[From the Springfield Republican.]

Now comes the United Gas Improvement company of Philadelphia with a proposition to lease the plant on what are regarded as most favorable terms to the city. Briefly, the offer is to take the plant for a term of 30 years, pay the city fully for the material and supplies on hand, to expend $5,000,000 within three years for necessary repairs, to expend $10,000,000 more for future enlargements and necessary extensions, to furnish gas of 22 candle power during the first 10 years at 90 cents a thousand cubic feet, at 85 cents in the next five years, 80 cents in the next five, and 75 cents in the next 10 years, to provide the city for public purposes with gas free of charge, and finally, at the end of 30 years, to turn over the plant to the city, together with the present property of the United Gas Improvement company, free of all obligations. The city also to have the option of resuming possession at the end of 10 years by paying to the company the appraised value of improvements plus interest at six per cent. on the same from date of contract. This offer is particularly calculated to impress people with the great value of such a franchise. It is being regarded most favorably. The Philadelphia Record is a stout champion of city ownership of the works, says the offer is worthy of careful consideration, and admits that public operation has had costly defects. But there is no hope of immediate reform in the public management, it says, and a lease on such favorable terms, which still leaves the city in possession of the franchise, is worth attention.

Business Sentiment Opposed to City Plant.

[From the New York Evening Post.]

The confessed break-down of the municipal gas-system in Philadelphia is a severe blow to the advocates of municipal ownership. A legislative investigation has finally laid the entire system so bare and defenseless that the business sentiment of the city is now strong for turning the whole thing over to private companies. It is amusing to read that the only argument made against this course was that of "calling attention to the rate at which gas is furnished by municipalities in England." The argument really is, a capable and honest government can run city gas-works; therefore an incompetent and corrupt government can do it.

The contest between the New York and Philadelphia Traction company and the Brunswick Traction company over right of way for construction of a trolley road between New Brunswick, N. J., and Somerville, N. J., a distance of 12 miles, has assumed large proportions. Each company has offered to pay $25,000 for the privilege. The New York and Philadelphia Traction company has built about two miles of its proposed road under a disputed franchise. It has secured the requisite number of consents, and deposited the amount specified by the township for the franchise, but the committeemen refused to act on its application.

CORRESPONDENCE.

New York Notes.

New York, October 19.—Amid all the political cares pressing upon him, Seth Low found time to entertain Lord Kelvin on Thursday last. In the the morning Lord Kelvin breakfasted with Mr. Low at the Holland House. Upon his arrival at Columbia University shortly afterward, he asked that he be excused from delivering an address to the officers and students, on the ground of fatigue. He said he wanted to learn, and not to teach. After examining the reading-room of the library and studying the details of the huge "moon" which reflects the electric light, he proceeded to the Physics building. He then went to West Hall, where an informal luncheon was served, at which the following-named professors were present: Ogden N. Rood, Charles F. Chandler, John K. Rees, William Hallock, Michael I. Pupin and Robert S. Woodward. Lord Kelvin was surprised that such buildings could be erected in two years, and expressed pleasure at the liberality of the wealthy Americans whose subscriptions made the new site a possibility. It is much more difficult to get such funds in England. He further announced that he soon expected to publish his lectures on "Molecular Dynamics," delivered at Johns Hopkins about 13 years ago. On Saturday Lord and Lady Kelvin took the steamer on their return to Europe.

During last week's testimony before the Supreme Court's Rapid Transit Commission of Inquiry, Stevenson Towle, formerly consulting engineer to the Department of Public Works, produced copies of contracts and other data relating to the cost of the excavations in the city streets, and from these drew the conclusion that Chief Engineer Parsons' estimates of the cost of excavation for the underground railway were not too low. W. B. Potter of the General Electric company was called, and said he had estimated the entire cost of equipment for the operation of the proposed road, including cars, motors and lighting, at $7,845,000.

John Van Horne, the veteran telegrapher, vice-president of the Western Union company, has resigned from the directory of that company. The resignation was presented at the annual meeting last week. Jacob H. Schiff was elected a director in Mr. Van Horne's place. Mr. Van Horne has been associated with the Western Union company for 47 years. His resignation was tendered because he desired to return to his home in Kentucky, as his wife was unable to live in the more rigorous climate of the North. The resignation was reluctantly accepted, after every inducement had been offered to have him reconsider his determination. The report of President Eckert gives the amount of capital stock outstanding as $97,370,000, of which $29,850.35 belongs to and is in the treasury of the company. The net revenue, expenses and profits for the year ended June 30, 1897, were as follows: Revenues, $22,638,859.16; expenses, $16,906,656.03. Deducting moneys applied for dividends, interest on bonds and sinking fund appropriations, there is a surplus to June 30th of $7,647,541.06. The assets and liabilities are placed at $128,410,498.42 each. M. S.

Washington, D. C.

Washington, October 18.—The directors of the Capital Traction company have formally determined to take action to put in the underground system of electricity on the Pennsylvania avenue and Fourteenth street lines, as provided by the General Electric company. It was also decided to commence the work of changing the conduits at once, and the contract for doing this was awarded to E. Saxton. A building committee consisting of President Dunlop, Henry Hurt and Samuel F. Phillips was appointed. This committee will take entire charge of the work of installing the new system. The contract with the General Electric company for the equipment of the lines will be drawn up and signed in a few days. The new system will comprise all of the latest improvements of a successful character applicable to underground electric propulsion of street cars, and upon its completion will be surpassed in its equipment by no other street railway system in the world.

It is recommended in the annual estimate for the expenses of the District of Columbia for the fiscal year ending June 30, 1898, that the use of arc lamps on resident streets should be avoided because they are annoying to many people in the summer months by their brilliancy and the insects they attract. It is suggested that $3,000 of the annual appropriation be set aside for experimental lighting with improved lamps. The marked increase in the appropriation for street lighting is explained by the following statement: "The existing service is not satisfactory or in keeping with the standards maintained in other branches of the city government. Nearly all the city streets and avenues are but dimly lighted, and some streets and populous alleys are not lighted at all. In many of the suburbs improvements are rapidly going forward and appropriations are not sufficient to furnish all the necessary lamps, even in those suburbs that are practically a portion of the city. Many of the important residential streets, particularly the broad and well shaded avenues, should be more brightly lighted, and all streets occupied by rapid transit lines should be lighted with arc lamps or other high-power lights." The need of a department of electrical control, says the report, is much felt, and the recommendation for it is renewed. T. I. P.

PERSONAL.

Charles Ackerman, president of the Central Electric Light company of San Francisco, is in Chicago.

Among the out-of-town electrical men in Chicago last week was E. Ward Wilkins of the Partrick & Carter company of Philadelphia.

William Hathaway Forbes, who has just died at the age of 57 years, was for a long time, says the New York Tribune, closely identified with the business and financial interests of Boston. He served gallantly through the war, and for eight years was president of the Bell Telephone company. His wife was a daughter of Ralph Waldo Emerson.

It will no doubt be a great surprise to the many warm friends of the Electrical Exchange, Chicago, to learn of the marriage of its manager, Thaddeus Selby Lane, to Miss Lillian Paynter, on September 30th. Miss Paynter is a resident of Long Island City, N. Y. There was considerable wonderment on the part of Mr. Lane's friends and also his employes as to where he was spending his "vacation," but now that the news is out there has been a general agreement that his increase of present responsibilities was the wisest step of his life.

ELECTRIC LIGHTING.

The village of West Liberty, Iowa, has awarded the contract for its electric lighting plant to Adams, Greene & Co. of Morrison, Ill. The work is to be begun at once, and the plant is required to be in operation by December 10th.

The Charleston (S. C.) Edison Light and Power company has applied for a charter. It will organize to purchase and operate the old Charleston Light and Power company's plant, which was in receiver's hands and recently sold. Additional machinery may be put in.

An ordinance, prepared at the suggestion of Comptroller Waller was passed at the meeting of the Chicago City Council on Monday. It authorizes the expenditure of $150,000 in the improvement and extension of the electric lighting system of the city.

Morelia is said to be one of the best lighted cities in Mexico. The plant belongs to the government and is under the management of Albert E. Lawrence, a Canadian by birth. It was established in 1888 and now supplies 116 arc and 1,075 incandescent lamps. It will be moved in a few months to a fine new stone building now in course of construction opposite the "Bosque" park, and a new dynamo with a capacity of 1,200 lights is to be added to those already in use.

ELECTRIC RAILWAYS.

The Louisville Street Railway company has paid to Attorney-general Taylor of Kentucky $25,147.55, the amount of the judgment recently rendered against the company for franchise tax, and has decided to abandon the contemplated appeal.

The September gross and net earnings of the Columbus (Ohio) Street Railway company are said to have been the greatest in the history of the company. It is reported that the company will buy the Columbus Central street railway, now in receivers' hands.

The Cleveland, Medina and Southern Railway company, which has filed articles of incorporation with the secretary of state of Ohio, proposes, is is asserted, to construct an electric line from Cleveland to Cincinnati via Columbus. The capital stock is fixed at $750,000.

The contract for building a standard gauge railroad from Cañon City to Cripple Creek, Colo., has been let by the Cañon City and Cripple Creek Electric Railway company to Orman & Crook of Pueblo. The road, as at present planned, is to be 30 miles in length, and must be ready for use on March 20, 1898.

An amicable understanding having been arrived at between the Chicago City Railway company and the Chicago General Railway company in relation to the use of the tracks in Twenty-second street, the suit brought by the latter company was dismissed by stipulation in the Supreme Court at Springfield on October 12th.

A clerk in the general office of the Albany Railway company, five conductors and one other man have been arrested for defrauding the company by using tickets a second time. The clerk in the general office sold packages of canceled tickets to the conductors, who then turned them in in place of cash fares collected. These operations have been going on for several months.

The text of the decision of the Supreme Court of Connecticut against the Shelton Street Railway company proves to be very important in its bearing on projected parallel trolley enterprises. It sustains the lower court in its finding that the financial strength or weakness of the proposed road must be considered in determining the question of public necessity and convenience. The practical effect of the decision is to compel all projected parallel trolley enterprises which have not heretofore passed the lower courts of Connecticut to prove their financial strength before these courts will approve them.

Corporation Counsel Flowers of Detroit has, on behalf of the city, began suit in the County Court to have the consolidation of the Detroit and the Fort Wayne and Belle Isle street railways (three-cent fare lines) with the Detroit Citizens' Street Railway company declared invalid. The bill of complaint asserts that the franchise of the Detroit railway, granted in 1894, expressly stipulated that it should not consolidate with the two old companies, and that the effect of the consolidation in management has been to curtail the service of the Detroit railway and make it merely an insignificant part of the Citizens' railway (six for a quarter) system, and also resulted in doing away with the continuous transfer system originaly operated by the Detroit railway.

The Milwaukee, Racine and Kenosha Electric Street Railway compay has filed with the council of Kenosha another application for a franchise and right of way through the city. This makes its third attempt to get through. Each of the former applications was rejected by the city, because it was unwilling to grant a franchise for 50 years, which was the term asked for. The ordinance now asked for is virtually the same as those rejected, with a few minor concessions to the city, which were contended for by the council. Mayor Cully says the company will not be granted the privileges asked for unless it is willing to give the city something which may be considered an equivalent. A local service is desired, and the aldermen want the company to secure the consent of at least three-fourths of the interested property owners. The company strongly objects to furnishing a local service which the citizens consider of any value. It is believed there will be another clash on these points. The road is now built to the north limits of the city and will be in operation within a couple of weeks.

The Chicago Times-Herald recently published the following: That there is some prospect that the Chicago and Northwestern will equip its suburban trains with electricity is indicated by the fact that an official of that line is now at Schenectady, N. Y., studying the third-rail system, as used on an experimental track there. This official is in company with General Superintendent Sullivan of the Illinois Central, which already practically has decided to equip its suburban service with electricity. Northwestern officials in this city admit that they are trying to keep abreast of the times and are closely watching the application of electricity to suburban traffic. As to whether there is an intention of adopting the system they are reticent. Aside from the Illinois Central, no railroad in the city doing a heavy suburban business is in as good a position to adopt an electrical equipment. Its tracks are elevated for the greater part within the city limits and it is possible to keep all trespassers from the right-of-way. The third-rail system could therefore be adopted without fear. That it is intended to find a new and cheaper motive power there is every reason to believe, for the competition of the electric lines tapping the road's suburban territory is already felt severely. Officials of the road have practically admitted this by reducing the price of 25-ride tickets and adding many trains to the already fine service within the last year. An electric line from Milwaukee soon will parallel its tracks for almost the entire length and a reduction of fares will then be necessary if its business is to be retained. Fare reductions under the present method of operation are not considered practical.

TELEGRAPH.

An underground telegraphic cable is now being laid to connect London and Birmingham in England.

From India comes another complaint against government telegraphs. It is charged that a press telegram intended for Indian Engineering mysteriously made its way into the office and columns of a Calcutta daily. The matter is now in the hands of the director-general of telegraphs.

TELEPHONE.

From information received at the State Department, it appears that a joint stock company, with a capital of 10,000 contos, is to be established in the Federal District of Brazil. This company has for its object the connecting of all of the state capitals of the republic by means of telephones, and has taken the name of Sociedade Telefonica Norte Sul.

The Home Telephone and Telegraph company of Fort Wayne, Ind., is an enterprising anti-Bell company. Its directory is handsomely printed and well arranged. In the book are the following interesting statements: "The Home Telephone and Telegraph company, Fort Wayne, Indiana, operates the largest telephone exchange in the United States in proportion to size of the city; has one 'phone for each 30 inhabitants; is not dominated by any trust or monopoly (Fort Wayne capital exclusively employed); was the first company in the state of Indiana using underground wires for electrical purposes, besides furnishing to the city free service

between all of its departments. It pays two per cent. of its gross income as a special tax, and is the only corporation within the city rendering it any compensation. It has reduced rates for telephones 50 per cent.; has improved the service 100 per cent., and is now furnishing connections to three times as many persons as were accommodated by the great monopoly."

Hon. Eugene Germain, United States consul at Zurich, has forwarded to the State Department the following report on telephones in France: There are at present 112 towns with a population of 6,000,000 which have 18,191 subscribers, half of whom are in Paris. It is not in Paris, however, that there are the most subscribers in proportion to the number of inhabitants, for at Cannes the proportion is 1 to 120; at Fourmics 1 to 198; at Mentone 1 to 205, and at Fourcong 1 to 222, against 1 to 253 in Paris. The article further shows how little the telephone is used by comparison with neighboring countries, like Germany and Switzerland, for while the number of "communicationes" in France last year was only 74,000,000, the total for Germany, excluding Bavaria and Wurtemburg, was over 424,000,000. Switzerland, with a population hardly the tenth of France, had at the end of last year over 1,000 miles of telephone lines, with 29,533 subscribers, and about 15,000,000 "communicationes." While the cost of telephones in Switzerland is more than covered by the receipts, the contrary is the case in France, though the subscription price is much higher than in any of the other countries, being as much as $80 per annum in Paris, and from $40 to $60 in provincial towns, to say nothing of each subscriber having to contribute toward getting connections to the Swiss system; in addition to the charge of getting an instrument put in and connected, the charge is $8 per annum and five centimes (one cent) for each conversation of three minutes' duration. The Swiss telephone system is operated by the government.

POWER TRANSMISSION.

A press dispatch from Mechanicville, N. Y., dated October 16th, says: Three hundred men are working night and day on the great dam now in course of construction at this place. The dam, when finished, will be one of the finest in the world and will aid in developing an electric power that will supply the entire Hudson Valley with electricity. The work on the dam is being pushed so rapidly that it is thought all the hydraulic work will be completed by November 1st. At the point selected for the hydraulic development, a small island, about midway in the stream, divides the flow of water into two parts. Across the channels thus formed concrete dams, having an aggregate length of about 1,000 feet, are being erected. The concrete of which these are composed is made of broken rock, brought from the quarries near South Bethlehem and Duanesburg. The dam is constructed with an almost vertical back and curved apron, deflecting the overflow water into a practically horizontal flow to eliminate all danger of washing away the sub-structure. At the ends of the dam massive piers of concrete of circular plan are anchored solidly into the rock of the shore. The power house is to be built integrally with the western portion of the dam, and, as in certain other modern structures of this character, uses horizontal turbines below the water level, the dynamos being directly connected to the shafts of these. The title of the corporation to control this electrical output is the Hudson River Electric Power Transmission company. It is expected that the current will be turned on from the plant about January 1st.

MISCELLANEOUS.

London Engineering describes the method of making welded steel barrels, which is now carried on at Uxbridge, England, under the Barrbeat-Stange patents. The body of the barrel is rolled out of steel plate, and buckling is prevented by easing the rolls at the ends. The rolls then bear only on the center of the sheet passed through them and thus extend the metal there and there only, the sheet remaining its original size at the edges. Under these condition it shapes itself naturally into the barrel form as the rolling proceeds, and when removed only requires its ends sheared straight in a special machine, and to have its longitudinal seam welded. This latter operation is effected electrically by the Bernados process, with which no skilled labor is required. The bent sheet is clamped with its two opposing edges some one-quarter or three-eighths of an inch apart; a small fragment of steel is placed over the opening and melted by means of the elecric arc by one man, while another stands by to hammer it as soon as ready. By welding on successive fragments in the manner named, the whole joint is finally completed, and the cask is finished by adding its heads and its bung bosses. The heads are first cut in a circular shearing machine, and then corrugated and dished in a 400 ton hydraulic press. The dished edge fits inside the barrel edge, and a ring of sheet metal three-quarters to one inch wide is also placed round the head of the barrel outside. The three edges of this ring, of the barrel itself, and of the head, are then melted together by the electric arc. The bung bosses are also welded on. These are steel stampings, and being much thicker than the sheet forming the barrel body, it is the practice after the weld is finished to place a heavy mass of hot iron on top of the work until the whole is cooled down. A certain annealing effect is thus secured by which possible contraction strains at the joint are avoided. The Uxbridge works of the company have a present capacity of about 240 barrels per week.

TRADE NEWS.

The Bibber-White company, 49 Federal street, Boston, Mass., has been appointed eastern distributor or Holm's "Tesoline" commutator compound, placed on the market by the Boiler Expurgator company, Chicago.

The Electric Arc Light company, manufacturer of the Pioneer inclosed arc lamp, has moved its offices to the American Tract Society building, 150 Nassau street, New York. W. C. Hubbard has been elected secretary of the company.

The Popular Science News for October says: "A properly made paint of graphite and boiled linseed oil is the most suitable for protecting structural ironwork, roofs, etc., exposed to the destructive agencies of heat, cold, storms, etc." The Jos. Dixon Crucible company of Jersey City, N. J., can give further information on this subject.

A. O. Schoonmaker, 158 William street, New York, one of the largest dealers in mica in this country, has made a change in his Cleveland agency, being now represented by Hayes & Arthur, Cuyahoga building, who are well known in the electrical trade. The firm named will carry a stock of Mr. Schoonmaker's mica, so that all orders will be filled promptly.

T. M. Crane, president and manager of the Pacific Coast Electric company of San Francisco, Cal., was in Chicago this week on his way East. Mr. Crane has secured a number of excellent specialties, among them being Okonite and Central Electric products. Mr Crane, who is also connected with the San Francisco Gas and Electric company, reports an excellent business on the coast, and states that the electrical business in that part of the country was never in a healthier condition.

The Lynn Incandescent Lamp company of Lynn, Mass., has experienced such a rapid increase in the growth of its business that it is obliged to open a sales department, which it has placed under the management of O. S. Burr, who will take entire control of the output of this concern for the United States. Mr. Burr has recently been in New York city and other points in the East appointing agencies for this concern. He will soon visit Chicago and other western cities in arranging for proper representation for the sale of the Lynn incandescent lamp in the West.

The Davis & Egan Machine Tool company of Cincinnati informs its patrons that Mr. L. E. Rhodes, formerly of the L. E. Rhodes company of Hartford, Conn., and prior to that for many years connected with the Pratt & Whitney company, has associated himself with the Davis & Egan company, and will have charge of the department in which are manufactured Lincoln millers, hand millers, etc. The company has secured an order from the Krupp Works of Essen for a number of machine tools, through its office at Dusseldorf, Germany. The Krupp Works are known to be the largest in the world, employing over 20,000 men, and it speaks well for any American house to introduce its goods into this immense manufactory.

General Manager M. E. Baird of the Eddy Electric Manufacturing company of Windsor, Conn., was a visitor in New York last week on his return from an extended trip throughout the central and western states. He reports a decided improvement in general business wherever he has been; he is convinced that the West is in better condition for the sale of electrical apparatus than it has been during the last three years. He reports that the Eddy company has the honor of the shipment of the first electrical apparatus into the Klondike gold mining region of Alaska, having sent from its San Francisco agency last week one of its six-kilowatt machines, with orders for several others on file for the same point, to be shipped as soon as transportation can be effected.

A notable addition to the already extensive electrical plant of the Niagara Falls Hydraulic Power and Manufacturing company in the power house at the foot of the cliff, at Niagara Falls, N. Y., will shortly be made in the form of a General Electric company electrolytic generator, which will be the largest of its kind ever constructed. It will be both liberally and carefully designed to enable it to cope with the very severe service of electrolytic work, i. e., for practically continuous operation. This machine will have 14 poles and will run at 257 revolutions, giving an output of 5,000 amperes at 175 volts, or a capacity of 875 kilowatts. It will be of the latest type and will be directly connected to the water wheel shaft. It will be provided with a special panel switchboard with full form K equipment of instruments necessary to handle a current of 5,000 amperes. The General Electric company is already well represented in the power house of the Niagara Falls Hydraulic and Manufacturing company. Two of its six-pole 560 kilowatt, 300 revolution, 650 volt railway machines are directly connected to the same turbine shaft, and supply current to the Great Gorge railway. In addition the station contains a "G E" booster and two other generators, one of 100 and one of 90 kilowatts.

The Standard Paint company of New York is erecting a large factory in Hamburg to supply the needs of its European trade in P. and B. insulating compounds. The company has had a good European trade for six years, but the length of time elapsing between the sending of the order and receipt of goods and the tariff in Germany were drawbacks. President Shainwald went over the ground carefully, and it was decided to erect a factory in Germany, Hamburg, with its fine facilities for foreign and domestic water transportation, being selected. The new factory will be ready next month to accept and deliver orders for European markets. The North and South American business will be supplied from the American works, as heretofore. The foreign sales office is in charge of the firm of Albert Noodt & Meyer, 33 Grimm, Hamburg.

BUSINESS.

The Peerless Rubber Manufacturing company of 16 Warren street, New York, will send samples of its gaskets, packings and other engineering goods to anyone desiring to test the merits of these products.

Everyone desires to keep informed on Yukon, the Klondyke and Alaskan gold fields. Send 10 cents for large compendium of vast information and big color map to Hamilton Publishing company, Indianapolis, Ind.

Much space in the Deming company's special catalogue of power pumps is devoted to electrical pumping, although steam and other pumps are made, of course. The Chicago office is at 61-69 North Jefferson street. Henion & Hubbell are the general western agents.

The illustrated descriptive bulletin of direct current (class "C") multipolar generators and motors built by the Keystone Electric company of Erie, Pa., is an excellent pamphlet. It should be added to the collection of every electrical engineer and contractor, and it will be furnished upon application.

Secretary J. G. Hickcox of the American Rheostat company, Milwaukee, passed through Chicago last week on his way home from an eastern trip. Mr. Hickcox reports a most encouraging increase in business. The American Rheostat company has recently installed 32 American crane controllers in one contract.

One of the handsomest catalogues ever issued by an independent telephone manufacturer has just been gotten out by the Standard Telephone and Electric company of Madison, Wis. It illustrates the many different types of exchange telephones, desk sets, switchboards, transmitters, etc., manufactured by the company. It also contains valuable information to purchasers and exchange subscribers and good advice to prospective telephone users in general. Over one dozen pages are devoted to testimonials from users of Standard telephones, which speak in the highest terms of the products of the company. The catalogue will be cheerfully mailed to any interested person upon request.

The Farr Telephone and Construction Supply company, 342 Dearborn street, Chicago, claims to be in a position to save money for all those desiring to purchase telephones and telephone supplies. This well-known firm handles everything used in a telephone exchange, and as it has special facilities for manufacturing its products it is in a position to make prices that usually secure the order. All those in the market for telephones, or likely to be at some future time, will do well to get the Farr company's catalogue before placing their orders. The company is also willing to forward to any address a copy of its handbook of useful information, which contains diagrams and illustrations showing how to connect telephones and also gives other useful hints.

The Ohio Electric Works of Cleveland announces that it has something new under the sun. Battery table lamps are the latest, and the company named, the pioneer manufacturer of portable lights with primary batteries, is the producer. This company first introduced the successful necktie light, then the bicycle electric light with primary batteries, which it has brought to a high standard of perfection, and afterward the carriage lights, with dry batteries, which have become popular. The popular priced table lights will undoubtedly have a large sale, and dealers can obtain exclusive sale by applying early for agencies. The new catalogue, for 1898, is now ready for distribution, and a copy will be mailed to anyone who mentions this journal. Address the Ohio Electric Works, Cleveland, Ohio.

The Ayers self-locking arc lamp windlass is not a new article and is reasonably well known to the trade. It has not, however, received the attention as a specialty which an article of this kind needs to get it properly before the buying public. The Electric Appliance company has recently taken up this article as a leader, which is a guarantee of the fact that the trade will become better acquainted with it. The Ayers windlass is probably the simplest

and most durable windlass ever constructed, being built to stand the wear and tear of rough work. It is also sold at a price which is a good deal of an inducement, and a great many of them should be placed this fall and winter. The only safe method of suspending lamps, the company claims, is the windlass arrangement, which is a little more expensive on the start, but is said to be the cheapest plan in the long run.

The Central Passenger association 1,000 mile interchangeable rebate ticket is for sale at principal ticket offices of the Pennsylvania lines. It is honored one year from date of sale for exchange tickets over either of the following-named lines: Ann Arbor; Baltimore and Ohio; Baltimore and Ohio Southwestern; Chicago and Eastern Illinois; Chicago and West Michigan; Cincinnati and Muskingum Valley; Cincinnati, Hamilton and Dayton; Cleveland and Marietta; Cleveland, Canton and Southern; Cleveland, Cincinnati, Chicago and St. Louis; Cleveland, Lorain and Wheeling; Cleveland Terminal and Valley; Columbus, Hocking Valley and Toledo; Columbus, Sandusky and Hocking; Detroit and Cleveland Steam Navigation; Detroit, Grand Rapids and Western; Dunkirk, Allegheny Valley and Pittsburg; Evansville and Indianapolis; Evansville and Terre Haute; Findlay, Ft. Wayne and Western; Flint and Pere Marquette; Grand Rapids and Indiana; Indiana, Decatur and Western; Lake Shore and Michigan Southern; Louisville and Nashville (between Louisville and Cincinnati and between St. Louis and Evansville); Louisville, Evansville and St. Louis; Louisville, Henderson and St. Louis; Michigan Central; New York, Chicago and St. Louis; Ohio Central Lines; Pennsylvania Lines west of Pittsburg; Peoria, Decatur and Evansville; Pittsburg and Lake Erie; Pittsburg and Western; Pittsburg, Lisbon and Western; Toledo, St. Louis and Kansas City: Vandalia Line; Wabash Railroad; Zanesville and Ohio River. The price of these tickets is $30 each. They are not transferable. If the ticket is used in its entirety and exclusively by the original purchaser, a rebate of $10 is paid by the commissioner of the Central Passenger association. E. A. Ford of Pittsburg, Pa., is the general passenger agent of the Pennsylvania company.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued October 12, 1897.

591,376. Signaling on Railways. Archibald C. T. Bond, London, England. Application filed May 14, 1897.

A railway signal comprising two rails and a return, batteries connected respectively with the rails and the return, contacts for rendering either of the batteries inoperative and a lever between the contacts for operating them, together with a cab electrically connected with the rails and the return, and carrying signal devices in the electrical connections.

591,395. Magnetic Coupling. Thomas J. Fay, Brooklyn, N. Y. Application filed September 30, 1896.

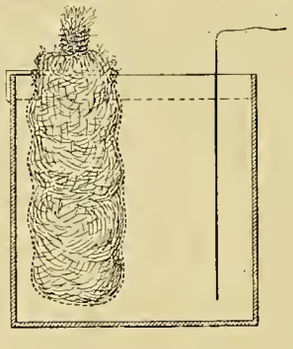
The combination of a hermetically sealed case, a machine therein having a main rotating shaft to be driven, a driving motor and its rotating shaft located outside of the casing, an electro-magnetic clutch having its two members mounted respectively on the two rotating shafts, one member being inside the casing and the other outside thereof, whereby the clutching and unclutching of the two rotating shafts may be effected through an unperforated wall of the casing.

591,426. Electrical Protector. Charles A. Rolfe, Chicago, Ill. Application filed January 11, 1897.

The device includes a cut-out for removing the instrument from the line, means for bridging the break caused by such removal, a ground circuit provided with a cut-out operating upon an excess of current therein, and means for including the ground cut-out in the ground circuit after the operation of the line cut-out.

591,427. Galvanic Battery. Charles B. Schoenmehl, Waterbury, Conn. Application filed February 2, 1897.

In the jar there is a perforated corrugated conducting basket containing a suitable depolarizing material; bolts pass through the basket securing the bottom and cover thereto; detachable insulating blocks rest upon projections of the bottom of the basket, and a circular zinc is supported upon the blocks.



NO. 591,571.

591,451. Electric Switch. John C. Cassidy, East Orange, N. J. Application filed March 20, 1897.

A new form of snap-switch is described.

591,486. Carbon Holder for Arc Lights. Oscar S. Moss, Syracuse, N. Y. Application filed January 28, 1897.

The top of this holder has an inner convex bearing surface; there is a side piece having both faces concaved, one of which is adapted to engage with the carbon, and the other with the inner face of the top, and means for holding them and the carbon together.

591,489. Trolley Wheel. Richard S. McPhail, Toronto, Canada. Application filed May 18, 1896.

Especial attention is paid to lubrication in the design of this device.

591,490. Fitting for Glow Lamps. Friedrich Palm, Nuremberg, Germany. Application filed May 10, 1897.

A holder for incandescent lamps, consisting of an insulated socket provided with spring pressure fingers for each terminal, these fingers being provided with outwardly curved portions near their ends, combined with the naked circuit wires suitably spaced apart, which are securely grasped by the spring pressure fingers.

591,491. Electric Switch. Joseph W. Parkin, Philadelphia, Pa. Application filed January 21, 1897.

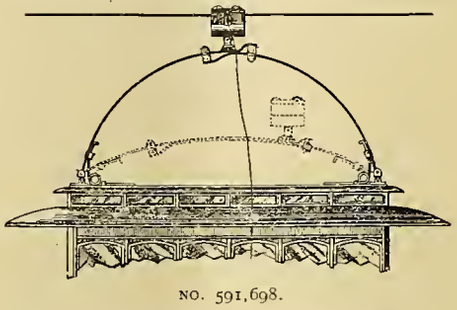
In an electric switch, a disk, a main contact strip thereon, a series of auxiliary strips on the disk, a second disk, contact strips thereon, conductors leading therefrom, an intermediate disk, contact plates on the intermediate disk and having a portion which is adapted to contact with the strips, and means for rotating the intermediate disk.

591,499. Electric Dental Mallet. Percy Russell, New Market, Md. Application filed October 6, 1896.

This tool appears to be constructed on the principle of the solenoid.

591,516. Electrical Rail Bond. William H. Wiggin, Worcester, Mass. Application filed April 26, 1897.

This bond is composed of an edgewise curved, flat-sided plate, and has a partial, flatwise twist in its central portion or body between the terminals.



NO. 591,698.

591,571. Process of and Apparatus for Electrolytic Recovery of Metals from Their Solutions. Joseph W. Richards and Charles W. Roepper, Bethlehem, Pa. Application filed January 7, 1897.

The process consists in first applying an electrically conductive coating to and throughout a highly porous mass of organic substance, having an extensive internal surface and penetrable by the electrolyte; second, in depositing the metal which is to be recovered upon the mass thus coated by constituting it a cathode in an electrolytic bath containing the metal in solution, and, third, in recovering the metal thus deposited by destroying the porous substance by heat.

591,590. Switch Apparatus. John P. Coleman, Swissvale, Pa. Application filed July 3, 1897.

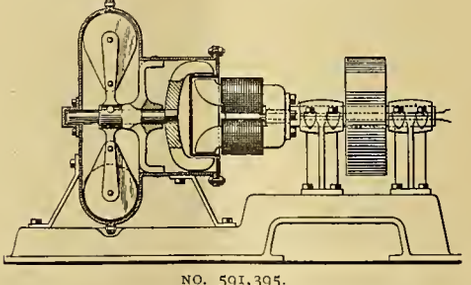
In an apparatus for shifting a part or appliance connected to a track for controlling the movement of trains, the combination of a motor, a generator having each of its poles connected to both poles of the motor, a circuit-changer controlling the connection of the generator to the motor, a magnet controlling the circuit-changer, and connections from the motor to the part or appliance to be shifted.

591,598. Igniter for Gas or Gasoline Engines. Milon O. Godding, Monrovia, Cal. Application filed February 3, 1897.

The stem of the electrical contact pieces is constructed with a square portion fitting into a correspondingly square hole in the insulating stuffing box.

591,623. Dynamo-electric Machine. Edward W. Farnham, Chicago, Ill. Application filed June 14, 1897.

The first claim enumerates the combination of a frame, an armature rigidly secured in the frame, a cylinder over the armature rotatably mounted on the non-rotatable axle of the armature, magnets secured in the cylinder so that the positive poles thereof are adjacent and the negative poles are adjacent, cheek-pieces uniting the positive poles and cheek-pieces uniting the negative poles, a commutator ring and collector rings on the armature electrically connected with the wound wire of the armature, and brushes rotating with the cylinder secured to such cylinder in electrical contact with the commutator and collector rings.



NO. 591,395.

591,624. Telegraph Key. Edward W. Farnham, Chicago, Ill. Application filed July 19, 1897.

Features are a depressible lever, an auxiliary depressible lever, a spring attached at its ends to the levers respectively, yieldingly holding them in a raised position, a contact point on the auxiliary lever and a spring anvil in electric connection with one of the main-line binding posts of the sending-key, whereby the depression of the first-named lever will force the contact point on the auxiliary lever into contact with the spring anvil and close the circuit in which the sending-key is placed.

591,625. Dynamo-electric Machine. Edward W. Farnham, Chicago, Ill. Application filed July 19, 1897.

The combination of a permanent C-shaped magnet, a frame in which the magnet is placed, an armature rotatably mounted in the end walls of the frame, a cylinder forming a casing to the armature, and an outer casing rotatably mounted on the ends of the frame with the inner peripheral surface of the cylinder forming part of the casing in frictional contact with the cylinder of the armature, so that rotation of the outer casing produces rotation of the armature.

591,641. Electric Meter. Gustave A. Scheeffer, Peoria, Ill. Application filed December 9, 1896.

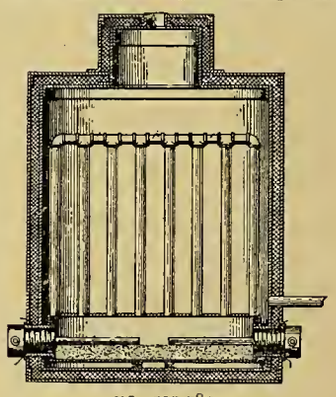
One claim reads as follows: In an electric meter, the combination with terminals connected with the measured circuit, of a body of fluid conducting medium electrically connected therewith, armatures immersed in said medium, means for directing current from the conducting medium through the said armatures substantially in radial directions, helices connected with the measured circuit and adapted to supply magnetic fields in which the armatures are rotatably mounted, whereby a torque is imparted to the same and a damping effect is obtained, and means for registering the rotation of the armature.

591,698. Trolley. George K. Shryock, Johnstown, Pa. Application filed April 23, 1897.

This novel trolley support consists of two arched springs arranged longitudinally with the car, and having a lapped and slip joint connection with each other at the top, and a separate lifting spring for each arch spring for forcing the arch springs up.

591,706. Electric Railway. David Urquhart and Frank Wynne, London, England. Application filed November 17, 1896.

This is a surface contact system in which are provided a suitable number of road contacts, a main conductor and electro-magnetic devices or switches for successively placing the road contacts in connection with the main conductor; there are also conducting guard-plates or rails located in proximity to the road contacts and adapted to be connected to the main conductor by the switch of the corresponding road contact, and to be then placed in parallel with the electro-magnetic winding of the switch.



NO. 591,783.

591,725. Protecting Alarm Circuit. Irvin E. Barriclow, Dallas, Tex. Application filed June 22, 1896.

The first claim describes a device for protecting electric circuits, combining a suitable alarm, an electro-magnetic device controlling the alarm and arranged to be held normally inoperative by a current of certain intensity, a circuit including both the alarm-actuating device and the distant object to be protected, pole-changers located in the circuit at the station and at the distant object, resistances adjacent to the respective pole changers and adapted to be alternately introduced into the circuit, and means for actuating the pole-changers synchronously.

591,730. Process of and Apparatus for Electrolyzing. Willy Bein, Berlin, Germany. Application filed June 15, 1896. Patented in Germany October 22, 1893; in England November 12, 1894; in France July 20, 1895; in Belgium July 20, 1895; in Hungary October 31, 1895, and in Austria May 8, 1896.

An electrolytic cell is arranged so that the chemically different layers formed by the electrolysis are allowed to remain undisturbed and unaltered as long as the current is passing through the cell; then fresh solution is fed to the intermediate undecomposed layer of salt solution, which should be retained at a certain depth, and the uppermost and lowest layers of decomposed products are withdrawn at a point outside the influence of the path of the current in such proportion as to retain a predetermined position of the respective layers. At the close of the electrolysis the layers are divided by means of interposed partitions which are made wholly impervious to the liquid.

591,783. Electric Heater. Oscar B. McClellan, Philadelphia, Pa. Application filed October 17, 1895.

A heater comprising an inner gas-tight receptacle containing an inert gas designed to circulate therein, an outer or surrounding receptacle separated from the inner receptacle by a heating space or chamber, a number of tubes extending through the walls of both the receptacles, and carbon candles or points arranged in the tubes and extending into the inner receptacle.

Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, OCTOBER 30, 1897. No. 18

Power and Lighting Plant in "The Fair" Building.

As may be readily surmised from the glimpses of machinery grouped in the accompanying pictures, the plant illustrated is not exactly a model one in arrangement or general plan. This arises largely from the fact that it is the result of successive accretions and was not laid out as a whole or in pursuance of any general design. It is used to furnish light, heat and power for the large edifice built and occupied by "The Fair" department store in Chicago, and which is illustrated by the small picture on the next page. The older portion of this structure was finished and occupied in 1891; the newer part was put up this year. It happens in consequence that part of the plant has been in use over six years, while another portion has been installed but a few months. In addition, machinery was added during the interval. Thus the collection is somewhat heterogeneous. It will be noted that the high-potential series arc machines, belted to the engines, are of the earlier date, while the low-tension, direct-coupled units, for both arc and incandescent lighting, are new. But the installation is principally interesting on account of its size. It comprises 10 boilers, 38 steam engines, 10 steam pumps, 18 elevators and 17 dynamos. The electric lighting engines alone are of 1,100 horse power capacity. It is worthy of note, too, that from the time the plant was started the building was never without light when wanted. There have been no break-downs to seriously impair the efficiency of the plant, which is in charge of J. G. Broman.

The plant is distributed about the western half of the basement of the building. The boilers are near Dearborn street. There are ten of them—six in the older equipment and four in the new—all of the tubular type. The old boilers are 60 inches in diameter and 20 feet long and were made by the Excelsior Iron Works. The new ones have dimensions of 66 inches and 18 feet, and were supplied by the National Boiler Works. Hollow grates are used in the furnaces, and forced draft is employed, the air being forced into the furnaces by two blowers driven by separate steam engines. Soft coal (nut and slack) from Ohio is burned, and combustion is aided by an iron stack 150 feet high and nine feet in diameter.

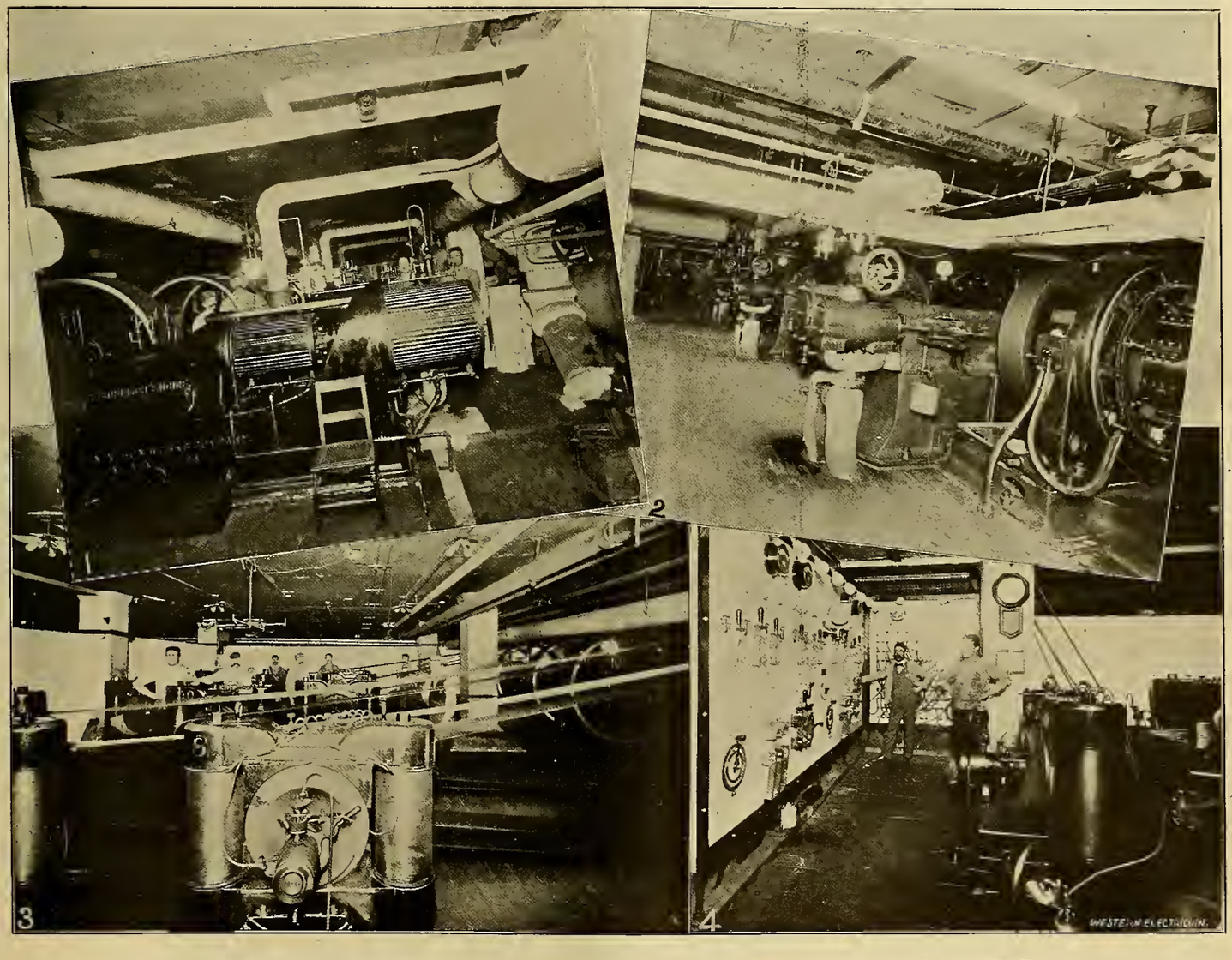
There is a varied assortment of pumps and small steam engines. Of the 18 elevators 12 are operated by steam and six by hydraulic power. Eleven of the elevators are for passengers and seven for freight. One fine, large triplex, high-duty pump, supplied by the Crane Elevator company, is used for the elevator service, and there are two auxiliary pumps for this purpose—a Blake pump and a Ludlow & Gordon duplex pump. Four Worthington boiler pumps are in use and two fire-pumps. The latter are also used in connection with a tank-and-gravity system of water distribution throughout the building.

Another use for small steam engines is found in the pneumatic air-tube system for cash delivery. Two blowers are used to exhaust the air from the tubes, and each has its engine. Several engines of small size are also used in connection with the heating and ventilating system.

Thirteen arc dynamos supply current to 540 series high-tension lamps of 1,200 nominal candle power each. These arc machines were made by the Standard Electric company, and they have a record of good service. The machines have a capacity of supplying current to from 50 to 65 lights each. The general illumination of the building is accomplished by arc lamps, and the number of series lamps was considerably larger at the time when a number of outdoor lights were used for advertising purposes. The arc dynamos are operated at 950 revolution per minute and are directly belted to three Dick & Church horizontal compound engines made by the Phœnix Iron Works. These engines have cylinder dimensions of 13 by 20 by 15 inches, and are rated at 200 horse power each. They are the largest engines in the plant and turn at 230 revolutions per minute, with steam at about 100 pounds pressure.

The newer generators are direct-connected. There are four sets of this class, all with Westinghouse multipolar direct current dynamos, wound for 125 volts output. Three of these machines have Ide Ideal engines and are of 100 kilowatts capacity each, and one, of 75 kilowatts capacity, is driven by a Ball & Wood engine. The current from these units is used to supply about 3,000 incandescent lamps of 16 candle power each, as well as 350 low-tension arc lamps wired across the incandescent circuits. Three motors are also operated—two to run coffee mills in the grocery department on the fifth floor and one driving a blower used in the ventilating system.

Two marble switchboards are placed in a corner,



1. Engines Driving Arc Dynamos. 2. Direct-connected Low-tension Units.
3. Arc Machines. 4. Switchboards.

POWER AND LIGHTING PLANT IN "THE FAIR" BUILDING.

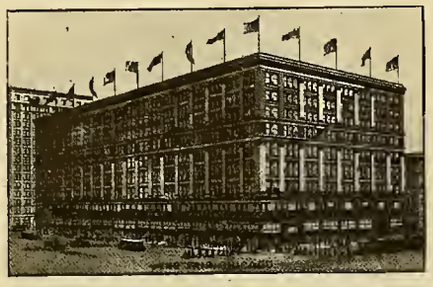
adjoining at right angles. The smaller one is used for the control of the arc circuits, with the usual plug-and-cord switches, while the other has been more elaborately fitted by the Western Electric company for the new plant. The large switchboard has rheostats with sunken contact segments, Weston instruments and knife switches. It presents a pleasing appearance.

Some of the Difficulties Existing in the Construction and Operation of Electric Street Railways.[1]

By George W. Knox.

With the smaller street railways, during the panic period, from which, it is to be hoped, we are emerging, it has been a struggle for existence, and a road that has pulled through these times without running behind may be considered fortunate.

The railway management has often during these



"THE FAIR" BUILDING.

times been called upon to make a good showing in dividends, having at the same time a decrease in earnings to contend with. How to do this has been a most perplexing problem for many a street railway manager. Failure to meet the emergency has resulted in a long list of roads in the hands of receivers.

I do not charge to the stock manipulators or the hard times all the receiverships of these railways. Many an electric road now in the hands of a receiver could be making neat incomes for the investors had a closer study and practice of the economic principles governing the details of construction and operation been made, and thereby done away with the many wasteful measures which are sapping the very life out of what might have been paying investments.

The keynote of doing this does not lie altogether in the ability to make one or two large reductions or savings, but rather in lopping off here and there the many unnecessary extravagances existing in the various departments of the system.

The first and most important step in working out economies is in selecting a corps of operators, from the head foreman down to the man sweeping out the depot. If they are interested and are working for the good of the company, scarcely an hour of the time in which they are engaged can go by without their effecting little savings which in time swell the item of economies to mammoth proportions.

The examples of how this is done are very numerous. For instance, had a certain motorman been the man for the position and exercised more care in operating his car, he could, perhaps, have averted an expensive accident case for his company. In a minor matter an armature winder, by being interested and more painstaking in his work, could, by insulating an armature coil with perhaps a thirty-second of an inch more insulation, have saved a burnout and an expense of $25 or $30. These are only examples of the many instances where a reduction in expenses is made possible.

In considering the question of our engines and electrical machinery, we have reached a state of comparatively high efficiency and economy, and there is not the chance of making the saving on these lines, in either the designing or operation, that there has been in the past.

There is also but little chance, in a broad sense, for argument upon such questions as feeder requirements, the necessity of ample and absolute return, cars, motors, etc. A general idea of what is required is so well understood that these problems narrow down to a study of how to accommodate the conditions as found, which the man in charge should be fully able to meet.

In the management of railway work the greatest opportunities for economy will be found in the details of construction and operation. It is totally out of the question for anyone to lay down a code of rules to be followed, owing to the varying conditions. The success attained in both construction and operation depends wholly upon the practicability of the man in charge of the work. What is greatly needed by those directly in charge of the equipment and operation of electric railways is a better opportunity for meeting each other to discuss matters of detail in construction and operation.

One of the mistakes into which we are most liable to fall is the rut of self-satisfaction with our own style of work. Then it is that the manifestations of decay and inefficiency begin. Those who are most satisfied with their own work are often the ones making the poorest showing. It is imperative, in order to eliminate the difficulties with which we meet, that we brush up against the other fellow and get his ideas. To be better able to do this, the plan now adopted by the electric railway companies of several states of having state meetings for the discussion of plans for better methods of carrying on the work should be made general. There are a few of these state organizations for the purposes mentioned, but there are not enough of them. The American Street Railway association has, I believe, too much of a national character to afford the time to take up and discuss details, of which the work is principally composed.

To these state meetings the companies should send the men at the head of the different departments, for which all concerned would be well repaid by the benefits derived therefrom. By keeping a man isolated, back in some dingy old shop or barn, he cannot be expected to be bristling with the bright ideas that bring forth the efficient service which characterizes the other fellow's road, and makes it a good dividend payer.

Following up the idea—that it is the first wrong step that counts—our whole aim must necessarily be to make as few mistakes in the construction as possible, for it is an easily demonstrated fact that the cost of operation depends largely upon the method of construction. It is an absolute necessity that we look ahead and plan against all kinds of speculative disaster, ignoring, if you please, in this case, the teaching that "we should not cross the bridge until we come to it." A little foresight which results in preventing an accident will probably mean the saving of the profits for many days' operation. One of the examples being (with ordinary conditions in the installation of overhead work) the use of but one insulation between positive and negative. For the first year or so this will be found sufficient, but a little later on the insulation begins to deteriorate, and there follows frequent short-circuits and burnouts, which stop traffic and entail an expense many times the cost of two additional insulations, which would insure to a reasonable extent against such leakages and burnouts.

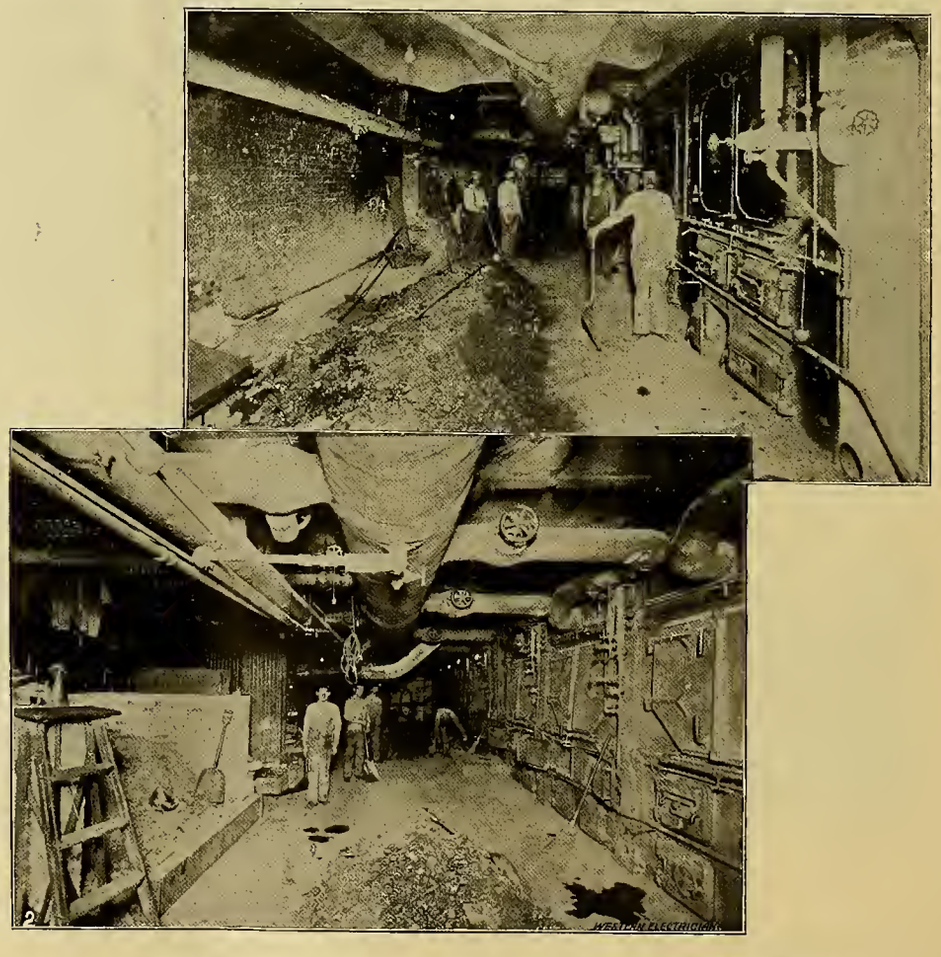
It is not fair to owners of the majority of the electric railway properties to say that they have worked on the retrenchment idea as regards expense in putting in the system, as, universally, they have been liberal with their money; but where they are to be censured is in the fact that they have not familiarized themselves more fully concerning the methods of installation. They have been inclined to leave the question entirely to the honesty of the contractor or supervising engineer, who was not necessarily dishonest, but a man who knew a good thing when he ran across it, and perhaps slighted the work accordingly.

Among the most important matters to study for economy connected with construction and operation is the supply department. There is an immense sum of money needlessly squandered in supplies and repairs for an electric road in a year. One of the causes of this waste lies in the fact that the roads have not yet arrived at a standard in the design of the apparatus which they use, to which too much importance cannot be attached. Every road should be its own designer of all articles used. Why should the manufacturer be better able to determine than you what is required? You are on your own ground, know exactly the conditions to be met and are in constant touch with the difficulties as they arise, and are far better able to devise the remedies than is the manufacturer miles away, who perhaps has only his own experiments and a confusion of theoretical speculations to rely upon.

I mean in no wise to decry the assiduous and most excellent work of the manufacturers of electrical apparatus. It was and is a field of necessary inventive development, and the manufacturers are sparing no effort or expense in their endeavors to supply the trade with the improvements in demand, but the unwary railway man has had an immense amount of experimental claptrap machinery inflicted upon him, all of which has cost dearly, and which is still maintained at a sacrifice. It is a lamentable fact that we have not done more than we have toward correcting this evil.

Along this line another evil for which the railway man, in his efforts to save money, is in part accountable, is the shaving of prices on material to the extent that it has resulted in competition being so sharp among the manufacturers of electrical supplies that they have adopted the piece-work plan in order that cheapness may be secured, thus turning out upon the market apparatus that was not gotten out for efficiency, but to fill orders. Of course these articles may have been built according to specifications, and stood the shop test, but there is demonstrated an entirely different proposition when this apparatus is put into actual use; it is then that we see the bad effects of the hurried and slighted work of the piece-workers.

To free ourselves of these troubles we must be more careful in getting out the specifications and checking up the material received. The most carefully prepared specifications in detail should go out for every piece of apparatus used; you will then find that your supplies are coming to you made up in the proper manner, your supply man



2. Old Boiler Room. 1. New Boiler Equipment.

POWER AND LIGHTING PLANT IN "THE FAIR" BUILDING.

1. Read before the American Street Railway association at Niagara Falls, October 19, 1897.

knowing that should he send out a mixed up and defective lot of material it will be promptly returned to him with charges "collect."

To be able to get out the specifications needed requires a certain amount of experimental work, and how far to go with this experimenting is a problem requiring the keenest discretion. Experimental work should only be encouraged and allowed by a company to the extent of having in view the elimination of an existing money-wasting evil. The testing, making of new designs and patterns, with perhaps the subsequent throwing in the scrap heap of the article gotten out to conform to some pet theory, when kept track of, are found to be a tremendous waste of money.

Experimental work should, however, be encouraged as far as it is profitable in the way of stimulating sagaciousness and promoting adaptability on the part of the men handling the work, but all experiments should be allowed only as passed upon by the management of the road, which should be fully competent to determine the probable practicability of the theory proposed.

In making up and buying supply parts, one of the factors of economy lies in the bulk to be used. Of course, the greater the amount purchased, the greater the saving. I would, though, strongly advocate not getting too great a quantity of stock of any kind of material on hand, as the defects developing often require the complete changing of designs, with consequent scrapping of all material in stock.

Another serious difficulty to be considered in connection with operation is the inefficiency of the motormen. I concur with a railway manager who once said: "Motormen, like poets, are born, not made." There are motormen who will operate a car day after day, year in and year out, without the slightest accident or complaint, while others are constantly having wrecks and their cars are always being run in the depot out of order.

In the calling of a good motorman we have a position with more responsibility attached, perhaps, than the position of an engineer of a steam railroad. A motorman, of course, has not in trust property that has the value of a steam railway train, but his field of operation lies where there is greater menace to life and property (for which his employer is responsible in case of injuries) than with a steam railway engineer. A trustworthy motorman should be required to pass a physical examination, possess a cool, collective temperament, judgment in cause and effect of ideas in general, and have a fair amount of mechanical ability. He should be obliged to undergo the most strict examination as to his fitness in these requirements, and, in addition, be thoroughly conversant with the correct methods and rules of how to handle the equipment.

The board of examiners for the fitness of employes on street railways will be able to make a better showing in efficient operation than most other departments by giving more attention to the examination and instruction of operators; and that there is needed improvement in this particular is evinced by the magnitude of the accident account, which is due mostly to the operators not being properly schooled in the work they are handling.

I do not believe in attempting to educate motormen to any extent in electrical knowledge, as it has been proven that it is a waste of time, and nothing is accomplished by it. By giving them an insight into and encouraging them in determining the cause and remedy of some electrical trouble with which they may meet on their cars while on the road, you will have men with all kinds of theories, wasting the company's time in tearing apart and dissecting the equipment, and perhaps not then locating the trouble; at the same time, they are undoubtedly blocking the line. Had the men, after failing with the simpler methods of locating the trouble, called for an emergency crew, or been pushed into the depot, they would have been doing much better service. There are, of course, some cases where it is excusable for men attempting the locating of trouble on their cars, but, as a rule, it is found to be the wrong practice. If they understand the brake mechanism, the proper manner of applying the power into their motors, how to cut out a disabled motor, and the rules as given in the rule books, they will have about all they are able to master.

A good, bright, interested motorman, or other operator on the system, upon noticing anything wrong with the equipment, should be educated to feel that it is his first duty to report everything coming under his observation that is working to the detriment of his company, and he should have this so impressed upon him that he will feel uneasy about his position until he does so.

It may be asked, What is to be done with employes in cases of carelessness and consequent losses through their action? Of course, it is out of the question to always avert accidents or mishaps, and specific rules cannot be laid down defining what is to be done in handling every case, other than by saying that it depends mostly upon ability to get the right kind of men and to instruct and impress upon them that the burden of preventing such losses rests entirely upon them. It is well to remember in disciplining men for offenses or carelessness in their work, that if they have clean records in the way of good intentions, they should be given another chance, as they will, in all probability, improve as a result of their experience, and make valuable employes for the company.

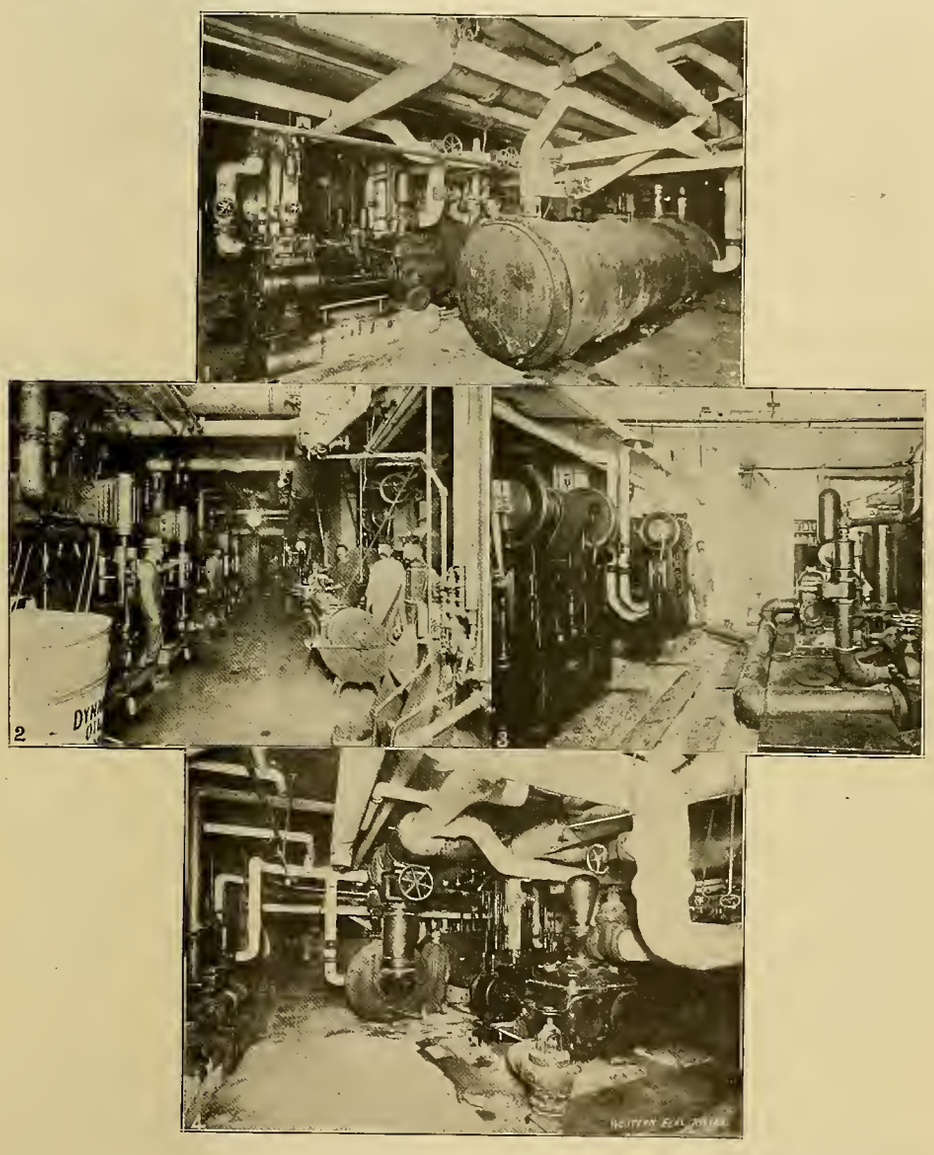
In placing a man in charge of work or a department he should be given the full responsibility of his position; then he will take an interest in what he is doing, have a little company of his own, so to speak, wherein he tries to save the dollars to the extent that he would were it his own. That is the way he should feel and act, and if he does not, his place cannot be filled too quickly. A company should, however, move with caution in making changes in heads of departments, also operators in general. A man assuming a new position usually comes loaded down with fertile ideas. They may have fitted perfectly the conditions existing at his former location, and believing that it is a poor rule which does not always work, he immediately proceeds to put into effect his ideas Some of them may be good, but usually by the time he has tried all of them the company (unless heretofore there existed a deplorable state of affairs) is liable to lose money by his practices.

I know of an excellent piece of railway property which should be paying good dividends. The company was born at a time when the experimental stage in electrical apparatus was well under way, thus enabling the selection of a fairly first-class equipment. They spent plenty of money on their installation, but as soon as the road was equipped the practice of changing management every three or six months was adopted. This resulted finally in their having about every style of apparatus. One of the managers came to the conclusion that he could make money by scrapping a style of motor he found on the road, so back in the corner they went. When his six months had expired, and the other fellow came on, he said he could make those motors go all right by changing their windings and otherwise fixing them up, and they were dug out of the scrap pile, the rust scraped off, new windings of field and armature substituted, and the motors are now in operation.

This practice costs money. There is nothing at all strange that this road should be struggling along for existence in the hands of a receiver, and I will not believe that overstocking or the hard times had all to do with its being in this position.

As a rule, the general condition of affairs out on the line and in the depots and stations of street railways is in a much shabbier state than exists in other lines of business. This is partially on account of the apparatus used being out in the middle of the street or back, maybe, in an old, dark barn, where no one really expects to see good order and cleanliness prevail; but it is a most serious mistake to allow this state of affairs to exist. Besides being directly wasteful of itself, it has the effect on every man connected with the company of making him generally careless and neglectful in his work. Out on the line it breeds contempt for the whole system in the public eye, and will act as a barrier to getting further concessions for lines. I can call to mind a repair depot, where the floor of the shop part is as clean as the floor of a Dutch kitchen, the walls and ceilings are neatly whitewashed, and there is an individual place for every repair part used, from the cotter pin of the trolley wheel to the truck wheels of the car. The repairman could be blindfolded in this depot and yet he would be able to go straight to and get any article of repair needed. There is no time lost in pulling out and hauling over material to find what is wanted. The results obtained by reason of these practices are highly profitable and wonderfully gratifying to the management. Neatness of the cars causes a minimum in the number of car trouble reports and amount of material used in repairs, while the car expense per day is no greater, and in most cases less, than that of other depots working under like conditions.

Much valuable time is lost and money thrown away by roads which are keeping so many records on matters pertaining to operation. Where a few records may be gotten out with a view of demonstrating that a leak is going on in some line of the work, or for the purpose of comparison in spurring some of the departments up when they are inclined to be negligent, there is of course money in it, and in fact it is necessary, in order that the work may be handled intelligently. But men often spend their time in keeping track of how long a certain armature ran, the length of time it takes to make repairs of a certain part of



1. Boiler Pumps and Feed-water Heater.
2. Elevator Engines and Machine Shop. 3. Elevator Engines and Auxiliary Elevator Pumps.
4. Fire and Boiler Pumps.

POWER AND LIGHTING PLANT IN "THE FAIR" BUILDING.

the motor, etc., making records which are rarely referred to, and should one want to use them, it would be necessary to spend as much time as it originally took to get them out in looking them up for use. This is all a waste of time and money.

The man in charge of a department should be able, when called upon, to show exactly what it is costing to perform any part of the work under his charge, but he should be able to have this knowledge without the constant keeping of a lot of records.

One of the most commendable practices employed in the maintenance of a street railway is the regular calling together of the heads of the different departments for consultation on matters pertaining to their respective departments. The details and new complications constantly coming up concerning the work are so varied and numerous, and the men actually handling the work have such an excellent opportunity of observing and dealing sucessfully with the difficulties arising, that their reports at once place the situation of affairs panoramically before the management for action. Some serious trouble with the equipment or operation may be going on; some one man, perhaps, has a way of remedying the difficulty, which the others had not though of, and again, practices that are extravagant may come to light during these meetings; so that those who have not tried this plan will find it a most valuable adjunct in methods of operation.

The subjects mentioned are, I know, being constantly thought about and worked upon by all street railway men, and are well understood by them, but there is no denying the fact that there exists with us in our work at times an unjustifiable and inexcusable amount of carelessness which results in the property depreciating as a money earner to the extent that the holders of street railway securities become disgusted, withdraw their holdings, the receiver is appointed and the road is branded as a failure.

FIG. 1. ELECTRIC TOWING ON FRENCH CANALS.—BOAT TOWED BY THE "ELECTRIC HORSE."

The remedy in most of these cases rests with the men who are actually handling the equipment, in assisting the management in keeping down expenses. How far this is accomplished resolves itself into the extent to which we go in getting the most practical men, who will be able to adapt themselves to and handle efficiently the conditions existing in their respective lines of work; and there must be constant vigilance on the part of heads of departments in taking advantage of the advancements being made and in thoroughly and constantly checking every man and his work.

Electric Towing on French Canals.

That most abject slave, the horse, who eats when fed and drinks at his master's option, goes or stands at his bidding, is being rapidly emancipated wherever electric traction can possibly be substituted. The trolley, overhead and underground, and the third-rail combination are plotting to free the life-long sufferer from the street railways, and ere long it may be reasonably believed that the automobile electric carriage will be substituted quite generally for the lighter road vehicles.

Even the tow-horse of the canals is too slow for this age of progress. Experiments have been made on several of the American canals, notably on the Erie, in New York state, looking toward the substitution of electric haulage, and, according to l'Industrie Electrique, there is a fair prospect that similar systems will prevail on all the French canals, and that electrical energy will perform the present work of the tow-path animal and do it better, more rapidly and with greater cleanliness.

The horse in towing being usually able to accomplish only a speed of about a mile an hour, several attempts have been made in the past few years to increase this rate by mechanical means, on several of the canals of France, among them experiments with steam power on the tow-path; but these were all failures.

Then, turning to electrical energy, several inventors sought to solve the problem on this line. The administration granted permission for the use of four kilometers of the Bourgogne canal by the experimenters. A turbine was installed in each waste weir. This was directly connected to a dynamo generating a current which, carried on an overhead circuit, formed a trolley line, whence it was carried to the motors on the canal-boats.

Official experiments were made at various dates on this four-kilometer section of the canal. A record of those of the 13th and 17th of December, 1895, at which a single generator furnished power, shows that the speeds attained with several towing and pushing boats were from 2.15 kilometers per hour to 4.24 kilometers against and with the wind, and a trifle higher average for the "electric horse" on the

FIG. 2. ELECTRIC TOWING ON FRENCH CANALS.—BOAT DRIVEN BY A TROLLEY PROPELLER.

towing path. The tonnage hauled varied from 76 tons light to 418 tons loaded.

At present the installation on the canal of l'Aire and la Deule is no longer an experiment, but an industrial enterprise. Two systems have been used—either the drawing of the boat by an "electric horse" upon the tow-path, or driving the boat direct by a motor. In either case the wire is tapped by a trolley. Fig. 1 shows the former, while Fig. 2 shows the latter method. Fig. 3 represents the "electric horse," and Fig. 4 the propeller system.

The "electric horse" is a motor, and it travels along the towing path, taking its current from an overhead line, which follows all the sinuosities of the water course, by a rigid trolley. The towing cable is attached between the two rear wheels. In front the single guide wheel is controlled through a beveled gear. The motor has a ring armature; the fields are in series; and it absorbs about six kilowatts. The shaft of the armature communicates motion to an endless screw of bronze which meshes into the toothed wheel of the drivers. These are of iron, and the felloes are covered exteriorly with cords of aloes fiber to give them elasticity and augment their adherence. Inside the cab are found the necessary switchboard and the steering gear, speed regulators and brake. The front of the cab has glass sash, so that the motorman, while protected from weather, can watch the road ahead of him.

The propeller, actuated by a motor, is a three-bladed affair, making 300 revolutions per minute. The efficiency of this combination is a little less than with the "electric horse" system, which, at 300 volts, is as follows:

Condition of boat.	Hourly speed.	Power.
Load of 387 tons.....	2 kilometers.	3.45 kilowatts.
Load of 186 tons.....	3 kilometers.	1.80 kilowatts.
Light (no load).	6 kilometers	0.9 kilowatts.

The total weight of the propeller and attachments is 700 kilogrammes.

The installation in process of completion on the

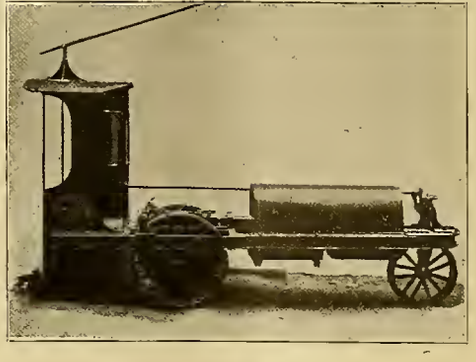


FIG. 3. RLECTRIC TOWING ON FRENCH CANALS.—THE "ELECTRIC HORSE."

Aire canals contemplates the annual handling of 3,118,286 tons, or 11,000 boats with 290 tons and 5,274 empty boats. The electric energy required is developed at two stations, at Beuvry and at Bauvin. These equipments comprise semi-tubular boilers of 135 square millimeters of heating surface, with 50 horse power engines making 95 revolutions per minute. Assuming that one kilogramme of coal vaporizes seven kilogrammes of water, the indicated horse power hour requires 1.5 kilogrammes, and the effective horse power hour for an efficiency of 80 per cent., 1.9 kilogrammes of coal.

The two stations will have three groups of outfits in constant operation. The output will be 144 amperes per station. The tension at the generator is to he 625 volts, with an allowance of 30 volts maximum drop on the line. The conductor is of chrome bronze, having 98 per cent. conductibility, supported on posts of Finland pine, at intervals of 40 meters. The return is made through earth connections.

Patents on Electric Cables and Accessories in Litigation.

Buyers and users of underground and aeriel electric cables will be interested to learn that the Standard Underground Cable company of Pittsburg, Pa., has entered suit against the National Conduit and Cable company of New York for alleged infringement of a number of its patents on cables, terminals, "T" joints, etc. The Standard Underground Cable company was the earliest in the field in this country as a manufacturer of electric cables and contractor for their installation, and its reputation is good.

The following patents are involved in the suit:

No. 242,894, relating in general to a duplex or two-conductor flat form of cable for telephone, telegraph or electric light service, this form of cable being especially economical in manufacture and installation, and especially well adapted, owing to its practical elimination of self-induction, for alternating current transmission.

No. 388,477, relating to what might be termed a "semi-concentric cable" composed of a central conductor or core, and a number of insulated conductors arranged spirally around the same, and having a cross-section greater in breadth than thickness, and composed of a number of smaller wires or strands, the purpose being to produce a flexible cable of the smallest dimensions, and also, by the position of the wires with respect to each other, and by including them under one lead cover, to reduce self-induction to a minimum, all of which

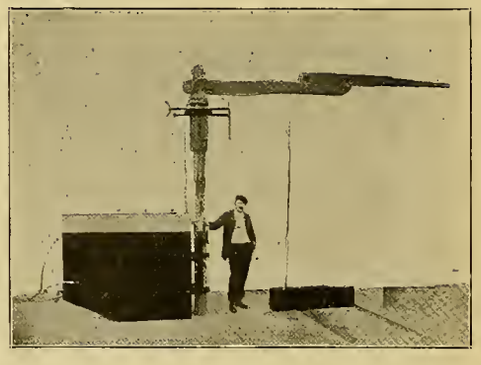


FIG. 4. ELECTRIC TOWING ON FRENCH CANALS.—THE TROLLEY PROPELLER.

are desirable and valuable features in electric light service.

No. 371,808, which is believed to cover generally the so-called "T-joint," or a metallic case or protecting shield secured around the insulated conductor joints between the main and branch cables. It is considered that a device of this kind is practically indispensable wherever branches or loops are to be taken from a lead-covered main or trunk line cable.

No. 395,546 is for a coating of tin or alloy thereof, or other material more durable than lead, as a protection against mechanical injury to the softer lead cover of the cable, and to resist the oxidizing action of acids, alkalies and similar agents that might work the destruction of a plain lead covering.

No. 574,343 relates to the well-known cable terminal head, tubular in form, and split in two longitudinal sections for convenience of joining the cable conductors to their respective binding posts, the sections being made of substantially uniform cross-sectional shape throughout their entire length and of such internal dimension as to make a tight joint with the cover of the cable when applied thercto, and provided with binding posts for connection with the cable conductors and the exterior distributing wires.

The suit has been entered in the United States Circuit Court for the Southern District of New York by Kerr, Curtis & Page of New York city, as solicitors, and Geo. H. Christy of Pittsburg, Pa., and Thomas B. Kerr of New York city, of counsel, and it is expected that these suits will be pushed to a speedy trial and decision.

Speaking of the new subways, the Boston Transcript says: "It is hard to realize that the street is overhead, and that the light and air that one enjoys are not the open air. Its peculiar diffusion, and the feeling that the light comes from all around one, as it does out-of-doors, is certainly a triumph of lighting, or engineering, or something, and its fine uniformity suggests a wish that the air and light up in Tremont street could always be as good. One almost envies the ticket-takers, starters and other imperturbable West End functionaries who live down there."

Echoes of the Street Railway Convention.

On the recommendation of Frank R. Ford, who represented the street railway interests at the National Conference on Standard Electrical Rules, the American Street Railway Association, at Niagara Falls last week, formally adopted the National Electrical Code. It is believed that all contributing interests have now adopted the code, which has, therefore, become fixed as the American standard.

In future the date of the convention will be not earlier than September 15th nor later than December 15th in each year. The executive committee is to fix the exact date and announce it not later than March 1st. The time latitude was given in order to meet the climatic exigencies of both northern and southern cities.

During one of the sessions of the convention the newly formed Street Railway Accountants' association appeared in a body. The young men were cordially welcomed by President McCulloch of the older body, and Charles N. Duffy of St. Louis made a pleasant speech of thanks.

The committee appointed a year ago to consider the advisability of the adoption of a standard code of rules for the government of street railway employes was continued for another year.

There was some discussion of the rates paid by the government for mail-carrying service, but no action was taken. Some of the members were satisfied with the price received, while others thought it too low.

Air-brake Installation.

Recently there were installed on the rolling stock of the Mason City and Clear Lake Traction company, running from Mason City, Iowa, a number of Standard air brakes. The service required of them was rather unusual. The company operates an electric locomotive which has been made out of a combination passenger and baggage car 45 feet long. This was equipped with the Standard Air Brake company's 1½ horse power electric compressor, governed by the company's automatic current controller. The locomotive draws a number of trailers, sometimes seven in one train. There are five open trailers, one closed trailer and one baggage and freight car, all of which are equipped with Standard air brakes. The trailers have 20 double seats with a center aisle, and have a seating capacity of 80 passengers. This makes heavy traffic, but the air brakes have proved fully equal to all demands made upon them. The entire train of eight cars can be perfectly braked with a low consumption of air. The trailers require only one pound of air and the locomotive two pounds for effective braking per stop. The trains make a speed of from 30 to 32 miles per hour along the line. For about a mile there is a grade of four per cent. The illustration shows the train, in the vestibule of which the Standard motor compressor is located. An excellent opportunity for demonstrating the value of these air brakes recently arose. The superintendent was running a train of locomotive and trailer, and while approaching the city, with speed reduced to 15 miles per hour, a runaway horse with buggy attempted to cross the track. This buggy contained a woman and three children. The superintendent made an emergency stop, which brought the train to a standstill four feet away from the buggy, which had been overturned by the frightened horse.

AIR-BRAKE INSTALLATION.

The assembly of the St. Paul council has authorized, by resolution, the joint committee on streets to investigate the affairs of the street railway company. Under certain conditions the company agrees to change the Selby Hill cable to an electric line.

An Artificial Moon.

In the illumination of the interior of the new library of Columbia University in the city of New York an artificial moon is used in the manner shown by the cut, which is reproduced from the New York Herald. Like the real moon in the heavens, this "moon" shines only by reflected light,

AN ARTIFICIAL MOON.

which in this case comes from eight arc lamp projectors made by J. B. Colt & Co. of New York.

The "moon" consists of a hollow sphere, seven feet in diameter, constructed of wood and painted a dull white. It is suspended 30 feet from the dome by a wire cable and hangs just above the four great arches of the library, so that when the light is thrown on it the arches are in shadow. On the second floor of the library, in the recess below everyone of the four great windows, is stationed a row of bookshelves. In the corners of every row stands an unobtrusive box of finished oak, about five feet high. There is no covering to these boxes, and in the depth of each burns a powerful arc lamp, whose rays are directed through a lens toward the wooden ball. Thus, the strong electric lights, often painful to the sight, are entirely hidden. As one walks about the floor of the library and looks up, the eight boxes in their respective corners seem portions of the woodwork. Even on the floor above, when one is groping among the books on the shelves, the electrical mechanism is hidden from view. Each one of the eight projections of light is about 75 feet long, and their combined radiance covers about three-fourths of the ball. The wooden sphere is intensely illuminated and reflects a light which is similar to moonbeams, being soft and diffused.

The idea originated with Prof. Hallock of the university, and Librarian Baker says that it has proved an entire success.

There is talk of electric lights for Pukwana, S. D.

Electric Carriages in Berlin.

From the report of the United States commercial agent at Berlin, it is judged that the Germans have developed nothing new in the application of storage batteries to carriages and railway cars, although the statement of the success of a street railway line using accumulators is interesting. Mr. Moore says:

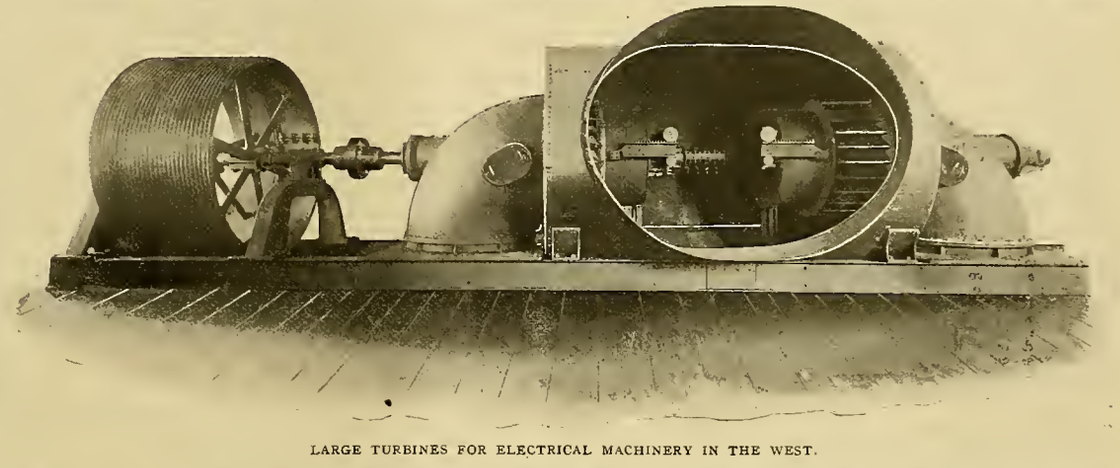
"The use of accumulators as a motive power for street railways having proven a success on the Charlottenberg "pferdebahn," there seems every likelihood for the further development of this means of locomotion in the city of Berlin. Already experiments are being made as to its application to motor carriages in addition to street railways.

"The great weight of the accumulators has hitherto been the most serious difficulty to overcome. Experiments are being made to reduce this feature, which seems to present a barrier to further progress. Another solution of the problem is being sought by constructing the cars so strongly as to enable them to carry the heavy batteries.

"Accumulator casings have been made from hard rubber, which withstood the vibration caused by uneven road surfaces, and at the same time, owing to their hermetical qualities, prevent the loss of the acids contained in the batteries.

"Trials are now being made in the Wostend and Moabit districts with a four-seated carriage, whose weight is 3,000 pounds, including the accumulator. On a level road, with a power of 30 to 35 amperes, it attains a speed of from 7½ to 9½ miles per hour. Steep gradients are not, of course, so easily traversed. It, however, climbs the Spandauer Berg, (grade 1 : 28) at the rate of four miles per hour, using 130 amperes.

"Strange to say, it does not show the minimum consumption of power on asphalt roads, but on a first-class Belgian block pavement. The reason seems to be that asphalt, being smooth, the wheels stick to it and the progress is retarded. Even a rather poor stone pavement does not offer the same resistance to speed that asphalt does. The turning on and shutting off the current, guidance and applying the brakes are effected with the utmost facility and security from the conductor's seat. The accumulators are placed beneath the passengers' seats. This new vehicle excited the curiosity of the public to the highest degree, the Berliner being, as yet, rather unused to rapid transit, and following the progress of the carriage with considerable astonishment."



LARGE TURBINES FOR ELECTRICAL MACHINERY IN THE WEST.

Large Turbines for Electrical Machinery in the West.

The illustration represents a pair of 51 inch McCormick turbines installed in station No. 2 of the Sacramento Electric Gas and Railway company, Folsom, Cal. This outfit was built by the S. Morgan Smith company, York, Pa., which two years ago furnished the same company with four pairs of 30-inch McCormick turbines of 5,000 horse power capacity, which continue working in a highly satisfactory manner at station No. 1. The turbines illustrated run on horizontal shafts and in an iron case with rope sheaves 10 feet in diameter, having 27 grooves for 1½ inch rope. The turbines develop 1,300 horse power and are driving a 750 kilowatt generator at station No. 2.

It is also stated that the S. Morgan Smith company has recently shipped the Bunker Hill and Sullivan Mining company a pair of 30 inch McCormick turbines, mounted in an outer iron case on a horizontal shaft, which are operating under 50 feet head, driving electrical machinery.

Another interesting contract is that with the Jordan River Electric Generating company of Salt Lake City to furnish two pairs of McCormick turbines of 1,600 horse power capacity, and two pairs each of 200 horse power capacity, to be directly connected to generators. Four of these turbines will operate under 75 feet head and two under 40 feet head. The manufacturing company is also to furnish two feed pipes 700 feet long.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

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TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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Thomas Jansen, being duly sworn, deposes and says that he is a resident of the city of Chicago, in the county of Cook and state of Illinois, and that he is the foreman of the printing department of the Electrician Publishing company, the publishers of the Western Electrician; that he was present at and superintended the printing of No. 24 of Vol. 20 of the Western Electrician, issued on June 12, 1897, and that there were printed by actual count 20,600 complete copies of said Western Electrician of the volume and number above specified. And further this affiant sayeth not.

THOMAS JANSEN.

Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

State of Illinois, County of Cook—ss:
Frank Foster Kenworthy being duly sworn deposes and says that he is a resident of the city of Chicago, in the county of Cook and state of Illinois, and that he is the superintendent of the binding department of the Electrician Publishing company, the publishers of the Western Electrician; that he was present at and superintended the binding of No. 24 of Vol. 20 of the Western Electrician, issued on June 12, 1897, and that there were sent out by actual count 20,000 complete copies of said Western Electrician of the volume and number above specified.
And further this affiant sayeth not.

FRANK FOSTER KENWORTHY.

Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

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Mr. Knox made a very readable paper for the Niagara Falls street railway convention. It is printed in full in the present number of the Western Electrician. Mr. Knox is a practical man, and his paper is full of practical hints. It necessarily deals with points often discussed, but as they are points that cannot be overlooked and always will be discussed, contributions from men of such wide experience as Mr. Knox will always be welcome.

Glasgow telephone users are not the only "kickers" in the United Kingdom. The London County Council has agreed "That it be referred to the highways committee to report to the council what steps can be taken to investigate the present position of the telephone service in the metropolis." It is complained that London has about the worst telephone service in England, but the Electrician has "no hesitation in asserting that in 1897 the London telephone service is nearly as good as the circumstances of the case permit." This is faint praise, and leads one to think that the service might be a great deal better. In this country, in these days of anti-monopoly in telephone operation, the Bell companies take care to give pretty fair service.

New Orleans may be an aspirant for the honor of entertaining the American Street Railway association in a year or two. A gentleman from that city intimated as much at last week's convention, and at his suggestion the possible date of holding the conventions was put as late as December 15th. The Crescent City has many attractions and would undoubtedly be looked upon with favor by many of the members. The meeting of 1894 was held in Atlanta, but aside from that the association has never visited a southern city, unless St. Louis be so called. If New Orleans can provide fitting accommodations for the association, whose annual gatherings are constantly growing larger, it ought not to experience great difficulty in getting the convention of 1899 or 1900.

Public recognition of faithful service is commendable, especially in large corporations, and as it tends to promote better feeling on the part of workingmen toward employers it is a wonder that it is not often adopted as the policy of companies conducting quasi-public enterprises. The Metropolitan Street Railway company of New York has decided to decorate the sleeves of the new uniforms of all its employes with service stripes, which will indicate the length of time the men have been in the employment of the company. For each year of service up to and including the fourth, the employe will be entitled to one blue stripe, and after the first five years all blue stripes are to be discarded and replaced by one gold stripe, and for every subsequent five years of service another gold stripe will be added. Some of the employes have been in the service for more than 30 years.

Those unthinking persons who indulge in glib repetition of the assertion that "electricity is still in its infancy" might well give heed to the fact that on October 12th the great German house of Siemens & Halske celebrated the fiftieth anniversary of the establishment of the firm at Berlin. "The event has caused a very great amount of interest," says an English contemporary, "and congratulations were presented at the celebration meeting by deputations from the Berlin, Charlottenburg, Vienna, St. Petersburg and London branches, and a number of presents were offered, including a portrait of Herr Werner Siemens, painted by Koner. Herr Carl Siemens read a deed establishing a fund of a million marks for the benefit of the workmen and officers of the firm, and providing for the appointment of a committee of officials to consider the best means of employing the money. Herr Wilhelm Siemens delivered a speech, dwelling upon the two guiding principles of the firm—scientific research and perfection of work. Congratulations were also presented by Herr Delbrueck, minister of state, on behalf of the Association for the Promotion of Industry, and by Privy Councillor Herz, on behalf of the Berlin mercantile community." Certainly, after this, no one can deny that the electrical "infant" has reached a sturdy manhood.

What with the increased traffic from service around the down-town loop and the prospective reduction of operating expense, due to electrical transmission of power, the prospects of the Alley "L" road were never brighter. The trials of Mr. Sprague's system of car control indicate that it will be successful under the usual conditions of practice, although, of course, it will remain for every-day experience with ordinary motormen to determine the point definitely. Certainly, the cars now on the structure at Sixty-third street are controlled with great ease and nicety. It is probable that a train of them will be tried on an electrically equipped road—perhaps the West Side Metropolitan—before the system is in operation on the South Side. The Alley "L" electrical equipment will have several other interesting features. One is the overhead trolleys which will be placed on all cars, in addition to the third-rail contact shoes, for use in the yards, where it is impracticable to lay a third-rail. Altogether, the road will be quite an exceptional one when it is in electrical operation.

Score one for the Allen law. At least one town in Illinois has recognized the wisdom of the measure which was passed by the last Legislature for the benefit of the street railway companies. Germantown, which is described as a suburb of Danville, has gained the distinction of being the first to grant a 50-year extension to the local street railway company. The population is small and the only general importance of the village consists in the fact that a street-car line passes along its borders from Danville to the fair grounds of the Vermillion County Agricultural society. The corporation owning this street-car line applied to the trustees of the village of Germantown for a 50-year extension of its grants. It was conceded without question. The cars run along a track which is but little more than a country road. Following so soon after the fight at Peoria, this movement is supposed to have some peculiar significance, but just what influence the action of an insignificant town can have on the rest of the state cannot now be determined.

A considerable portion of Mr. Hewitt's important paper on the "Application of the Storage Battery to Electric Traction" is presented in this issue. The author is the electrical engineer of the Union Traction company in Philadelphia, and, considering three applications of accumulators in railway work, he naturally devotes a large portion of his paper to the one with which he is presumably most familiar—the use of the battery at the ends of long feeder lines. This use he approves under certain conditions, and he gives an interesting mass of data relating to the Chestnut Hill plant of his company. Mr. Hewitt also favors the employment of batteries in generating plants to even up the load line. But he does not regard the storage-battery car as a promising factor in street railway work. He thinks that the outlook in this direction is not brght and does not "look for much improvement unless some combination of elements be discovered whose characteristics are entirely different from the lead battery." Specifying the Englewood and Chicago road, which has been built and so far operated with great care to show what storage-battery cars can do, Mr. Hewitt is still incredulous. He says: "Great results are expected from the experiments now being made in Chicago; but great results have been expected before, and I do not look for results in Chicago much different from those that have preceded. It is claimed that the batteries in use in Chicago will show a much longer life than any that have as yet been tried. But even if the life of the plate were all that could be desired, we would not feel warranted in recommending the system."

In the use of batteries on the cars, success in operation, on level roads, seems to be practically assured. The final verdict turns on the question of economy. It is physically possible to operate the cars; but is it financially practicable? That is a question that is now awaiting the showing by the Chicago road.

An Experiment with the Electric Arc.

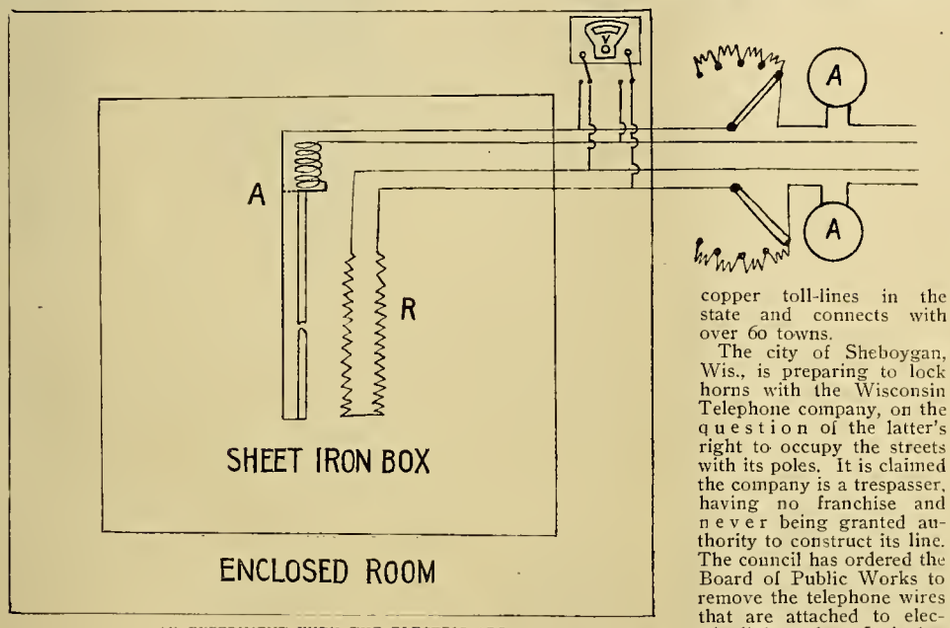
By W. R. Bonham and Harold Almert.

Having followed with interest the many valuable discussions in the late technical journals regarding the phenomenon of the electric arc, we record an experiment recently performed by us which we think may throw some light on this interesting subject. The object of the experiment was to determine whether or not a counter-electromotive force exists in the electric arc.

The method employed was as follows: The total heat energy of the arc was measured and compared with the total energy absorbed by it, on the assumption that if the total heat energy equaled the total absorbed energy of the arc, it would indicate an absence of a counter-electromotive force, and the presence of something in the nature of a resistance in its stead, while if the values of the heat energy and the absorbed energy varied greatly it would favor the assumption that a counter-electromotive force existed.

An Adams-Bagnall constant potential enclosed arc lamp was used to eliminate as far as possible errors due to the heat of combustion of the carbon. As will be seen by the diagram, the arc lamp was enclosed in a sheet-iron box four feet square. This box was placed in a small inside room of a capacity of about 700 cubic feet, containing no window or transoms and but one door. Two pair of leads were brought into the room, one pair being connected to the lamp, while the other pair was connected to a small iron wire resistance R, also placed in the box.

Provision was made for measuring the voltage of either circuit inside of the test room by means of a Whitney voltmeter and double-throw switch, while



AN EXPERIMENT WITH THE ELECTRIC ARC.

the current in either circuit was regulated and measured by means of a Thomson-Houston regulator and an ammeter in each circuit, located in an outer room. The current in the arc lamp circuit was measured by an Edison ammeter, while the current flowing through the resistance R was measured by a Whitney ammeter. While neither of these ammeters had been standardized, they were compared with each other before and after the experiment and found to read the same. The inside temperature of the box at one point and the temperature of the room at two points were recorded by standard Centigrade thermometers.

The arc lamp was permitted to burn for 9.5 hours with 4.65 amperes at 119 volts, when the temperature of the box and room were found to remain constant at 38.5° C. in the box and 24.75° C. in the room. The heat which maintained this constant temperature was produced in the mechanism, resistance coil and arc of the lamp.

To determine the heat produced by the arc, the carbon holders were short-circuited, as at A, and the current through the mechanism and resistance of the lamp again adjusted to 4.65 amperes, thus keeping the heat generated in those parts constant. Current was then sent through the resistance R and adjusted until at the end of four hours the same constant temperatures of 38.50° C. in the box and 25° C. in room were obtained.

The energy thus expended in the resistance R (5.8 amperes at 71 volts) must evidently equal the heat energy of the arc, since the temperature produced in each case under constant conditions are the same. The total energy consumed by the arc lamp=119×4.65, or 553.35 watts. The energy consumed by the mechanism and resistance of the lamp =36×4.65, or 167.4 watts. This, subtracted from the total, leaves 385.95 watts representing the energy consumed by the arc. The energy consumed in the resistance R necessary to produce the same heat as that of the arc=71×5.8, or 411.8 watts, leaving a discrepancy of 25.85 watts, which, under the circumstances, we consider an allowable error.

While we do not pretend to account for the abnormally high resistance present, we think that the experiment proves beyond a doubt that the phenomenon is not due to a counter-electromotive force.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the Western Electrician.]

J. P. Estee is about to put in a telephone system at Miller, S. D.

The Wisconsin Valley Telephone company is arranging for quarters in Chippewa Falls, Wis., for an exchange, and will soon construct a system in that city.

The Wisconsin Telephone company is preparing to meet competition in several cities in Wisconsin by a reduction in rates. At Eau Claire a reduction is announced, to take effect January 1st or sooner, to $30 for business instruments and $18 for residences, with a further reduction of 10 per cent. on these rates on three-year contracts. Further, the company will meet any rate made by the opposition. The same rates are to go into effect at Chippewa Falls at the same date. At the same date in Oshkosh the rates of the Wisconsin Telephone company will be advanced from $24 and $12 for business houses and residences to $30 and $18, the same as the Northwestern company's rates to that city.

The Rocky Mountain Bell Telephone company of Helena, Mont., has just moved into its handsome new building, erected at a cost of $30,000. It is of granite, and equipped with every modern appliance known to telephone users. This company has between 800 and 900 miles of metallic circuit copper toll-lines in the state and connects with over 60 towns.

The city of Sheboygan, Wis., is preparing to lock horns with the Wisconsin Telephone company, on the question of the latter's right to occupy the streets with its poles. It is claimed the company is a trespasser, having no franchise and never being granted authority to construct its line. The council has ordered the Board of Public Works to remove the telephone wires that are attached to electric light poles. It is believed the city will make the telephone company take the case into court as plaintiff.

The Inland Telephone and Telegraph company contemplates constructing a long-distance telephone line between Arlington and Heppner, Ore.

The Fountain City Telephone company of Fountain City, Wis., will extend a line through Mondovi to other towns in Buffalo county.

The Werner-Dwelle Telephone company has begun setting poles for its exchange at Lake City, Minn. This company will connect with Oak Center, Zumbro Falls, Mazeppa and Hammond.

The Dakota Central Telephone company contemplates locating a station at Beardsley, Minn.

D. H. Campbell has been granted a franchise for a telephone exchange at Brookings, S. D.

The Hanamo Telephone company, which has been granted a franchise at Clarinda, Ia., for a local exchange, will build south to Marysville and other Missouri towns.

The Western Electric Telephone company will connect with the Winnebago Valley Telephone company's toll system at Mankato, Minn., at once.

Minneota, Minn., now has a local telephone exchange, which is owned by the Southwestern Minnesota Telephone company.

P. G. Reynolds, superintendent of construction for the Northwestern and Southwestern Telephone companies, has gone to Arkansas, to superintend the laying of a cable across the Mississippi River, from Helena to Trotter's Point. The cable is for the use of the Southwestern Telephone company. He will be absent about a month in Arkansas and at his southern headquarters, Waco, Tex.

New telephone poles are being placed between Minneapolis and St. Paul. The old poles were not tall enough to keep wires clear of the trees and were becoming rotten. All of the present telephone wires will be transposed to the new poles and new wires strung. The poles are planted in an adamant foundation.

Owen & Hille of this city have been awarded the contract for the new Indian school and equipment at Vermillion Lake, Minn., which included a complete electric light plant.

The telephone line between Minneapolis and Willmar is now complete, and the exchange offices are being rapidly equipped.

The Twin City Rapid Transit company is planning to extend its present field of operations by constructing a new power dam at Coon Rapids, in the Mississippi above Minneapolis, where it is estimated 12,000 horse power can be made available. The preliminary surveys have been made, and representatives of the company are at work securing flowage rights. The new dam is not to furnish power for the operation of the street railways, but is a commercial investment. The site of the dam is admirably adapted for manufacturing concerns and has the best railway facilities also. Work will be commenced probably some time this winter, unless the engineers decide to wait for more favorable weather.

Electric Railways in Dublin.

When the New York State Street Railway convention was held at Niagara Falls in September, there were present William M. Murphy and J. B. Concannon of the Dublin United Tramways company. They had come to America on important business connected with the conversion of the entire Dublin tramways system into an electrically operated service, and the convention above referred to being in session, they took opportunity to attend it on pressing invitation. This was not Mr. Murphy's first visit to America, for two years ago he came to this country to investigate electric railroading, and traveled over a greater part of the states at that time. Returning home, his company secured permission to equip the whole of the Dublin system with electrical apparatus, and then began to cast about to find where they could purchase the necessary machinery at the best price. They found that the American manufacturers were the leaders in this industry, and so they came here to make the necessary contracts.

On his return to Ireland Mr. Murphy spoke of the results of his American trip as follows:

"We purchased machinery of various kinds at an expenditure approaching nearly £150,000 and at about two-thirds of what we had estimated the cost would be six months ago. Moreover, by our personal contact with the manufacturers we believe we have done better by from £20,000 to £30,000 than we should have been able to do with English manufacturers, or by correspondence with American manufacturers. We have further the satisfaction of knowing that we have been able to place our contracts at these low prices with firms of the very highest reputation in the United States. We are, therefore, as you may suppose, thoroughly satisfied with the result of our visit and feel amply repaid for our time.

"With regard to the electric traction system, we found it has extended everywhere, and now prevails in American cities to the almost exclusion of horses, and the system is also becoming rapidly extended for suburban and interurban communication. In some cases electric lines connect outlying towns 30 and 40 miles away with some of the large cities.

"We expect to spend from £250,000 to £300,000 on the conversion of the horse tramways into electric tramways, and if we obtain the powers for extension, which are shortly coming before the Privy Council, we shall spend about £100,000 more. The capital for the scheme has already been provided. We are working immediately on the extension of the electric lines from Haddington road to Nelson's Pillar, and from Annesley Bridge to Nelson's Pillar, the Clontarf line being already equipped. We have power enough in our present station to work those lines. We shall build a new central station from which the whole of the tramways will ultimately be operated, and as fast as the materials can come forward from America we shall equip the whole of the city. I expect that within less than 18 months from this date (October 9th) there will not be in the city of Dublin a tramcar drawn by horses.

"As to speed, under our new act we have no limit except such as the Board of Trade and the local road authorities may prescribe. They travel very much faster in America than even our Dublin and Dalkey line before objection was raised to it by the railway company. We find the feeling, both at home and abroad, is in favor of rapid transit, and what the public want they must get sooner or later. I expect that we shall be restricted to eight miles an hour in the center of the city, which will be quite speed enough, but that when we get out into the suburban roads a speed of 12 miles or more an hour will be sanctioned.

"Under the terms of our act of Parliament there will be a considerable reduction of fares when electric traction is introduced. For instance, we may not charge more than a penny from the center of the city to the city boundary, where the distance does not exceed a mile and a half, and the fares from the extreme ends of the present lines to the center of the city, which are now threepence, will be, in most cases, reduced to twopence."

General Eckert, Colonel Clowry and several other officers of the Western Union Telegraph company are making a tour of inspection west of the Mississippi.

Street Railway Situation in Terre Haute.

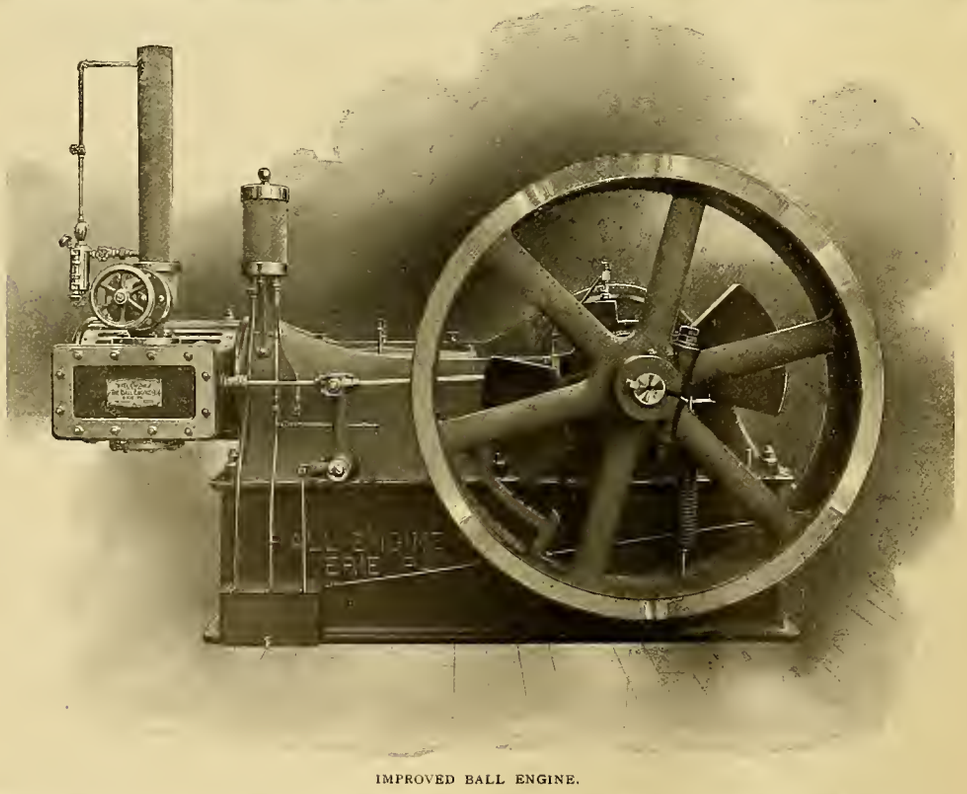
Suprise is general that the Terre Haute Electric Railway company, of which Russell B. Harrison is president, should have been placed in the hands of a receiver, as was done last week. The company owns and operates the entire street railway system of the city, owns and operates the Citizens' electric lighting plant, lights the city streets by contract, and sells exhaust steam for heating throughout a considerable section of the city. It has a capital stock of $500,000, and has issued $900,000 in bonds, $400,000 of which is in escrow to retire the outstanding bonds of the old Terre Haute Street Railway company, which was absorbed by the present company.

The claim on which the receivership was sought and granted is for back taxes, but the trouble seems to be due to municipal opposition rather than to financial distress. A dispute with the mayor has grown out of an indebtedness for street paving assessments. The company contends that, under an act of the Legislature, this indebtedness may be rightfully cared for by a bond issue. The mayor's signature was required for the proposed bonds, and this his honor refused to give, asserting his opinion that the law was unconstitutional. The company's counsel contend that the act is constitutional, and that the city would not be responsible for the bonds. On Monday of last week the city treasurer made an early morning levy, and then the mayor made affidavit to the indebtedness and threw the company into a receivership. It is said that the city council did not authorize the mayor's action, being in ignorance of his intention. For several hours the cars did not run. The receiver is now operating the property, and will continue to do so, of course, until a settlement is made.

A gentleman who is interested in the affairs of the company says: "The sentiment of the community is overwhelmingly with us at the outrage, and the citizens are very indignant at the action of the city officials. The company has paid already this year $5,000 into the city treasury on account of street paving assessments, and was given no notice that a levy was intended. The City Council, believing that a serious blunder had been made, and to show its feeling, unanimously adopted a resolution on Tuesday of last week, complimenting the management of the company, and requesting the receiver to retain it. There has never been a case before in this state where a receivership was applied for in a tax matter, and those well informed do not think such a step can be taken in the matter of street paving and assessments under any condition."

Improved Ball Engine.

A pleasing appearance is made by the Ball single-cylinder engine as now improved, and as shown by the illustration. This engine is equipped with the new Rites governor and automatic lubricating system. The governor was illustrated separately and described in the Western Electrician of August 21st last. It is a combination of inertia and centrifugal forces, and not only regulates to a very high degree of perfection, but with very rapid adjustment, and without instability or racing. It also has the advantage of great simplicity, as the entire governor consists of but a single moving piece suspended upon one pivotal point, thereby reducing friction to a minimum.



IMPROVED BALL ENGINE.

The lubrication of the engine is accomplished by the use of the gravity system of supply to graduated sight-feeders located at the various oiling points upon the engine. This system becomes automatic through the use of a pump that is driven continuously from the valve motion, delivering oil into the tank. The pipes are so connected that direct pressure may be established on the supply pipes for the purpose of removing any obstruction that may occur. The gravity system of oiling seems to have many advantages over the splash or direct forcing system, for in these systems, in the process of elevating the oil to a sufficient height to feed over the engine, the oil becomes aerated, but in the gravity by pumping into a tank there is opportunity for the air to leave the oil; consequently each of the feeds show clear oil instead of an oil that is almost saponified by being filled with air. The oil, after having been distributed over the running surfaces, gravitates down to the bottom of the inside of the frame, and from there is led out to the front end of the frame and through an inclined pipe down to a receiving tank setting near the floor level. Here the oil passes through one or two screens to remove any floating particles of foreign matter, and is then pumped to the supply tank above the engine in a much greater quantity than is called for to supply the engine, the surplus being carried back to the receiving tank by an overflow pipe. This arrangement insures an absolute flood of oil, if desirable, over the engine, as well as a supply of oil for a long run without the use of the pump.

The Ball Engine company of Erie, Pa., manufactures this engine.

Electricity Applied to Plant Life.

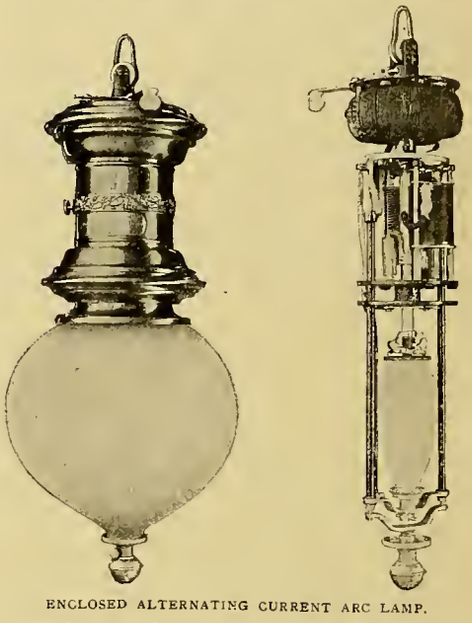
A. S. Kinney, of the Massachusetts Experiment Station, has written the Agricultural Department at Washington concerning experiments he has made in the application of electricity to plant life. Mr. Kinney used batteries—four Leclanche cells, arranged in series, giving an electromotive force of four or five volts, and two Samson cells, giving an electromotive force of 2.88 volts. In order to secure a larger variation in the force obtained, a Du Bois-Reymond induction coil was used.

In applying the stimulation, moistened seeds were placed in glass cylinders, and the opening was closed with copper disks, to which the wires were attached. Another method of applying the stimulation consisted of a glass funnel, in which were two copper disks, the upper one containing twelve holes. Between the two disks was a layer of moist sand, in which the seed was planted, and connections were made so the current would be passed through the whole apparatus. When this apparatus was used, the seeds were first germinated in sawdust, and when the radicles had reached a length of two centimeters they were transplanted to the sand. The plants which were investigated to ascertain the effects of electricity in the germination and growth of radicles were white mustard, rape, red clover and barley. Twenty-five seeds of each kind were used in 64 lots. From the results of the experiments Mr. Kinney concludes that the application of certain strengths of electric current to seeds for short periods of time accelerate the process of germination. It was found at the end of 24 hours over 30 per cent. more seeds were germinated of the treated lots than of the normal ones; and at the end of 48 hours there was about 20 per cent. excess. The seeds receiving the electrical stimulation also gave a higher total percentage of germination than the others. The minimum strength of current at which acceleration was barely perceptible is a little less than one volt.

The seeds subjected to but a single application lost the stimulating effect within a few hours; but when it was applied hourly to germinated seeds or growing plants, it acted as a constant stimulus to their growth and development.

Enclosed Alternating Current Arc Lamp.

Perhaps the most objectionable features of some alternating current enclosed arc lamps that have been placed on the market have been their too low economy and noisy, uncertain action. In the new alternating current arc lamp manufactured by the General Electric company these characteristics are said to be overcome. It operates on constant potential alternating circuits with higher economy and greatly diminished noise. The principles of the enclosed arc lamp and the economical advantages of its use over open arc lamps are familiar, but as between open and enclosed alternating arc lamps, it is not so generally known that a greater difference in economy in favor of the enclosed lamp is shown than in the same comparison between open and enclosed direct current arc lamps. In the "G E" alternating current enclosed arc lamp, one pair of carbons will last between 60 and 70 hours, and induce a saving of about 80 per cent. in the cost of lamp carbons; a larger arc is maintained; the light is emitted without obstruction; and its protection from currents of air and any sudden action of the mechanism allows the light to become and remain steady.



ENCLOSED ALTERNATING CURRENT ARC LAMP.

The mechanism is simple, the number of moving parts being reduced to a minimum, and its action is quick and positive. A special adjusting spring keeps the current constant whatever the position of the core. The mechanism is supported on a frame with a double base, which gives a dead air space and provides protection for the mechanism from the heat of the arc.

This lamp operates on circuits of 100 to 120 volts and 60 or 125 cycles frequency. About 70 volts is required at the terminals of the arc, the normal current being 5.5 to 6 amperes. An inductive resistance contained within the ornamental top of the lamp, and connected in series with the arc, gives the necessary reduction in the voltage, and, preventing sudden changes in current, checks any unsteadiness of the light. The half-inch carbons used are 9½ inches long in the upper holder and six inches in the lower—one cored, the other solid—and they must, of course, be of high grade. They are proportioned to allow the piece left in the upper holder after one run to be used in the lower holder for the next. The inner globe is supported by a self-locking device. To lower the globe, the lower ball is unscrewed, the globe raised slightly and released by turning the release screws on the side of the cylinder. To replace it, the globe is simply raised until it locks, when it is tightened by screwing up the lower ball.

The General Electric alternating current enclosed arc lamp is 28¼ inches in length and 31⅛ pounds in weight. It is artistic in its proportions and is judiciously ornamented. For interior illumination, i. e., for halls, large stores, restaurants, theaters public buildings, the casing of the lamp is finished in ground brass or black enamel; for outside use a weather-proof casing is furnished.

Ortonville, Minn., voted $15,000 bonds for an electric light and waterworks plant.

Application of the Storage Battery to Electric Traction.[1]

By Charles Hewitt.

Part I.

To give a history of the application of the storage battery to electric traction would only be turning over dry bones. The long series of remarkable failures is no doubt familiar to you all. To say that the storage battery has no place in electric traction is an error, and on the othe hand, to say that it will supplant all other means of applying power to the cars is, I believe, only the dream of the enthusiast. We are sufficiently acquainted with the possibilities and limitations of the storage battery of to-day to be able to make installations whose success will be certain; improvements in manufacture have certainly been made during the past few years, but the cause of past failures has been due quite as much to errors in installing and in manipulation as in manufacture.

In preparing this paper I have made an effort to obtain accurate information from Germany, France and England, but all such attempts have been of no avail. As far, therefore, as the state of the art in Europe is concerned, we must rely upon what we have been able to gather from current literature.

The most important applications of the storage battery to electric traction are:

First—The application of the battery direct to car or locomotive.

Second—The application of the battery at points on the line distant from the generating station.

Third—The application of the battery in the power house.

Application of the Battery Direct to Car or Locomotive.

We are led to consider this form of application first, not on account of its successes, but rather on account of its conspicuous failures. From our investigation we can see nothing in this form of installation to commend, except for certain local conditions which are peculiar to the large cities on the continent of Europe.

The first cost is greater than our present overhead form of construction, and the expense of operation is considerably greater; in fact, it is doubtful whether the expense of operation can be brought below that of horses. It is less reliable and more objectionable to passengers on account of the gas given off. But very little reliable data is obtainable from all the various experiments which have been made. Most all such experiments, in this country at least, have been made by the battery manufacturers, and the results obtained have been most carefully guarded. Mr. Dawson, in an article published in Engineering, October 16, 1896, says: "Two principal causes have so far prevented the successful use of the accumulator cars: their great weight and the rapid deterioration of plant. Owing to these causes, the manufacturers of storage batteries only have seriously taken up accumulator traction, and although they have been working on the problem since 1880, little reliable information has ever reached the public."

In a paper read by the writer before the Engineers' Club of Philadelphia, December 5, 1896, I gave in detail results of a test made by me of a certain battery car. The main results agreed quite closely with data which has come to us through European publications, and I feel confident in stating that the battery car requires considerably more power to operate than an ordinary trolley car of the same size and under the same conditions, and further, the battery car will require a larger investment in generating machinery. The unreliability of the battery car, and the disadvantages due to the necessity of constantly changing the batteries, are familiar to you all, and we have no facts which would warrant us in holding out any hope of improvement in this line. In fact, unless some form of battery be discovered with entirely different characteristics from the lead battery, I should advise leaving such experiments to those who enjoy spending money on this kind of a hobby.

When the action of the battery is thoroughly understood it is not difficult to understand the cause of failure. Every battery has what may be termed a critical rate of discharge. From zero up to the critical rate the working electromotive force remains practically constant. Above the critical rate the electromotive force decreases as the rate of discharge increases. On the other hand, the electromotive force increases with the rate of charge and the length of charge. From any particular battery there is a rate of charge which cannot be exceeded without useless waste of energy. In Fig. 1 I have shown typical curves for charge and discharge at normal or critical rates, and the portion between the curves represents lost energy. In Fig. 2 I have shown the discharge curve taken from a traction battery test. With a fairly constant discharge at the average rate used by the car, with rests of one minute every 15 minutes, the fall of electromotive force is very marked. You will appreciate, therefore, the remarks of Sir David Salomon, "that it takes power to get current through the battery, and it also takes power to get the current out." These critical rates of charge and discharge seem to be partly due to the time required for the chemical reactions in the battery to take place. The physical limitations of a car require the battery to have a large output for its weight and bulk. To obtain this it is necessary to increase the surface of active material as much as possible and to decrease the inactive supporting grid. In consequence the battery plates become mechanically weak. The conditions seem to prevent the making of plates large enough to prevent exceeding the critical discharge rate, and which are at the same time light enough and small enough to be carried on a car. The inherent characteristics of the lead battery are such that it is very doubtful whether it will ever be successful in propelling cars unaided by other sources of power. Great results are expected from the experiments now being made in Chicago; but great results have been expected before, and I do not look for results in Chicago much different from those that have preceded. It is claimed that the batteries in use in Chicago will show a much longer life than any that have as yet been tried. But even if the life of the plate were all that could be desired, we would not feel warranted in recommending the system.

There is another phase of this method of application which is used somewhat extensively in Europe. In some of the larger cities on the continent there is a prescribed area within which overhead lines are not allowed to be erected. To overcome this difficulty the cars are supplied with batteries sufficiently large to propel them at a low rate of speed for a distance of three or four miles from the point where the overhead line ends, into the city and return. While the cars are completing the trip the batteries are charged from the overhead wire. I am sure such an arrangement would not commend itself to any practical railroad manager, except as a makeshift in such government-ridden cities as exist in Europe. There are only two cities in this country where such an arrangement might reasonably be considered, and in those cities the slotted conduit has (and I believe wisely) been adopted.

The advantages of this method are apparent. Aside from the lack of overhead lines in the crowded city center, which is purely æsthetic, the most marked advantage is the lack of necessity for changing the batteries for charging. But this advantage is offset by the fact that as the charging is done en route the current for charging must be transmitted over the feed wires in addition to the current necessary for propelling the car with its extra weight of battery, thus increasing the loss due to charging. The power transmitted may be divided as follows: First, to propel the car without battery; second, for propelling extra weight of battery; third, for charging battery.

I regret that I have been unable to get accurate data showing the relation of these items to each other. But I feel satisfied that the extra cost of feeder cables due to the extra power transmitted and the decrease in efficiency, will more than offset any saving in cost of linework, while the cost of operation must be and is acknowledged to be in excess of the less complicated system in common use in this country. The fact that overhead lines are in use up to the prescribed limit and that the battery is only used where it is compulsory, speaks volumes. It is also significant that the commissions appointed by the larger roads in England and Scotland to investigate the various methods of traction in vogue throughout Europe and America have vetoed any form of battery car.

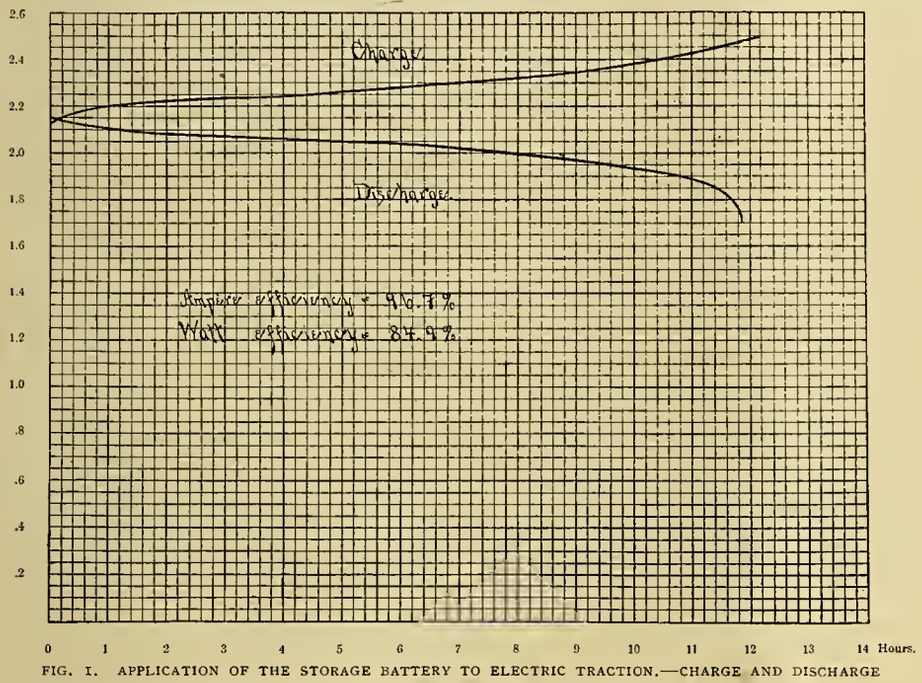


FIG. 1. APPLICATION OF THE STORAGE BATTERY TO ELECTRIC TRACTION.—CHARGE AND DISCHARGE CURVES.

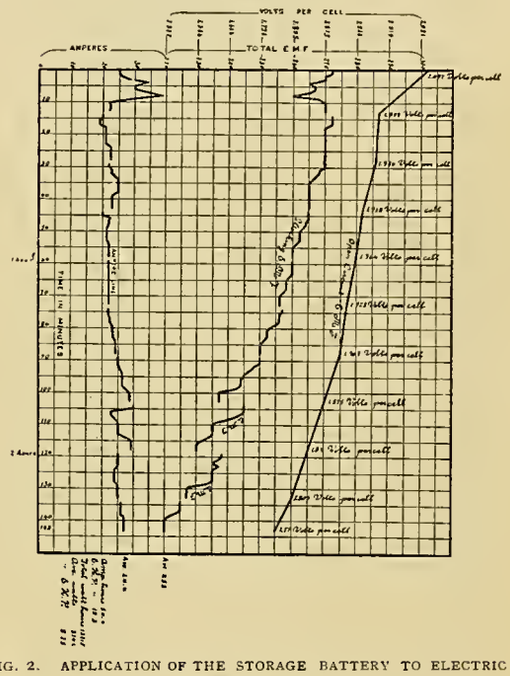


FIG. 2. APPLICATION OF THE STORAGE BATTERY TO ELECTRIC TRACTION.—BATTERY DISCHARGE THROUGH RHEOSTAT.

The following data are taken from the writings of Mr. Dawson and others:

Comparative Data of Accumulator Cars.

	Paris.	Berlin.	Vienna.
	Lead.	Lead.	Copper and Zinc.
Passengers carried	50	31	32
Empty car, weight in pounds	18,081	19,845	16,097
Loaded car, weight in pounds	25,799	24,630	21,036
Weight of cells	3,749	7,270	3,969
Number of cells	56	88	136
Capacity of cells, in ampere-hours	230	130	300
Power per car-mile required at power house, in Board of Trade units	1,120	1.072	1,280

Data of Accumulator Cars Running in Paris.

Number of cells	108
Number of plates per cell	11
Size of plates, in inches	7⅞ by 7⅞
Thickness of negative plate, in inches	.236
Thickness of positive plate, in inches	.315
Weight of plates, in pounds	59.69
Capacity in ampere-hours	250
Efficiency per cent	70
Average discharge rate	35
Maximum discharge rate	100-120
Life of negative plate, in car-miles	93,750
Life of positive plates, in car-miles	8,750
Passengers carried	50
Weight of loaded car, in pounds	30,870
Weight of cells, in pounds	6,615

Data of Accumulator Line at the Hague, 1891 (Julien Accumulators).

Length of line	3.5 miles
Maximum grade	1.50
Weight of car, loaded	14 to 16 tons
Number of cells	192
Weight of cells	4 tons
Maximum speed, in miles per hour	12.5
Maximum distance run with one charge	44 miles
Average distance run with one charge	35 miles

1. Read before the American Street Railway association at Niagara Falls, October 20, 1897.

Capacity of cells, in ampere-hours per pound of plate 4.5
Positive plate can run without renewal.....
.....9,000 to 11,000 miles
Cost of maintenance of cells per car-mile.....8.5d
Cost of handling cells per car-mile.....2.3d
Board of Trade units, consumed per car-mile..1.080
Probable maximum discharge rate.....130 amperes

A third phase of the battery-car system is the battery locomotive. Aside from special forms such as the Heilman locomotive, the one most worthy of mention is the experiment on the New York elevated railway, in which the battery is connected in multiple with the motors and charges or discharges, according to the demands of the train. When the demand of the motor is sufficient to due to the fall of the electromotive force on discharge.

Only a few such installations have been made, two of which are on the Isle of Man. One has been installed by the Anaconda Mining company at Butte, Montana. There is also a small plant at Merrill, Wis. The first installation, however, that has been made for any large city road for its sub-

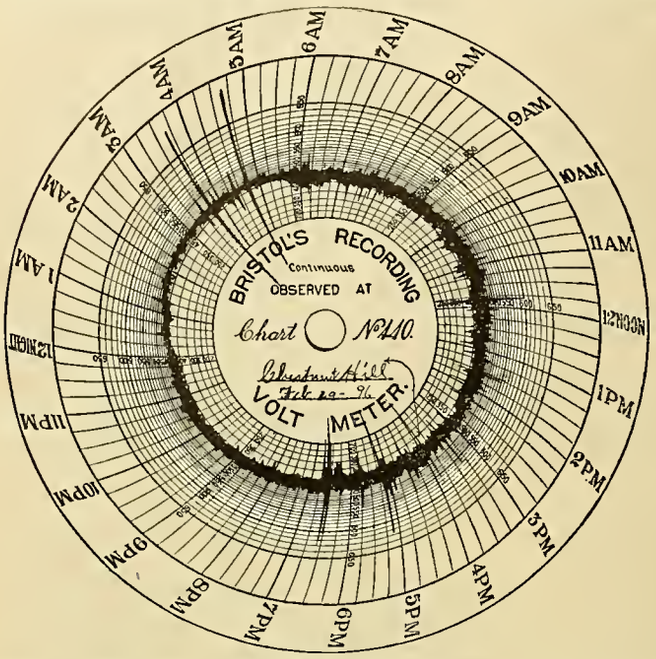


FIG. 3. APPLICATION OF THE STORAGE BATTERY TO ELECTRIC TRACTION.—VOLTMETER CHART TAKEN AT CHESTNUT HILL BEFORE THE BATTERY WAS INSTALLED.

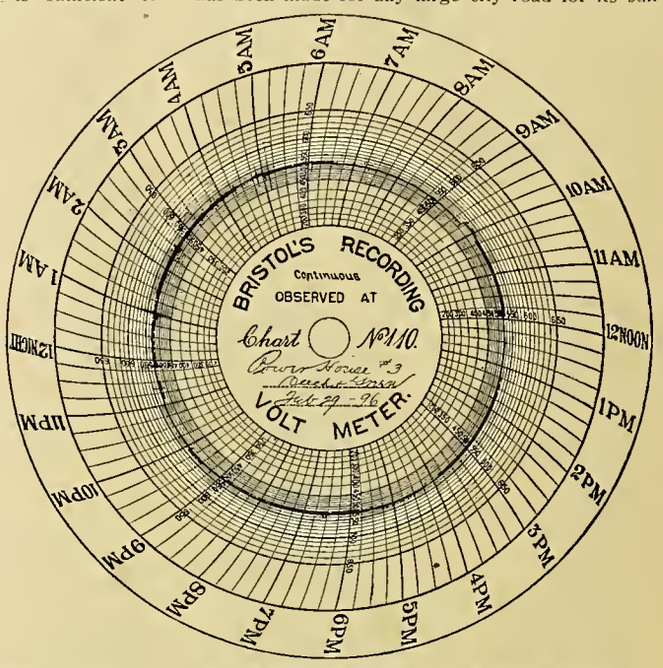


FIG. 4. APPLICATION OF THE STORAGE BATTERY TO ELECTRIC TRACTION.—VOLTMETER CHART TAKEN AT BEECH AND GREEN STREET POWER HOUSE.

Cost of Running Accumulator Cars in Birmingham, England, per Car-mile in 1893.

Wages	3.37 pence	6.74 cents
Fuel	1.76 pence	3.52 cents
Stores	.68 pence	1.36 cents
Water and gas	.12 pence	.24 cents
Sundries	.17 pence	.34 cents
Repairs and maintenance	5.49 pence	10.98 cents
	11.29 pence	23.18 cents
Car-miles run		140,993

Working Expenses of Accumulator Traction in Paris in 1893 per Car-mile.

	Pence	Cents
General expenses	.204	.408
Cost of power	2.828	5.656
Maintenance and handling of accumulator	2.537	5.074
Motormen and assistants	1.210	2.420
Maintenance of motors and trucks	1.410	2.820
Heating, lighting and various	.138	.276
	8.327	16.654
Miles run		144,718

Comparative Cost of Various Systems of Traction in Paris in Cents per Car-mile.

Horses	17.10 cents
Accumulator	16.66 cents
Hot water locomotion	10.78 cents
Overhead trolley system	9.24 cents

lower the pressure on the line to or below that of the battery, the battery will then discharge into the motors, thus relieving the feeders. When current is shut off from the motors, the battery will charge. No results of this experiment have been made public yet, but it is difficult to see how much is to be expected. It has the advantage of maintaining a fairly constant pressure at the motors, but this can be accomplished better in other ways, as I shall show later. It subjects the battery to usage which history has proved to be disastrous to its life and efficiency. In this method the extra weight of the battery has the certain advantage of giving additional adhesion to the rails.

While not wishing to seem pessimistic, I must confess that to me the outlook for the battery car is not bright, and I do not look for much improvement unless some combination of elements be discovered whose characteristics are entirely different from the lead battery.

Application of Storage Batteries on the Ends of Long Lines.

In such applications the conditions are entirely different. The battery in this case acts essentially as a pressure regulator. The conditions do not restrict the size of the plates, so that the plates can admit of such a size that the current density on discharge can be kept well within the limits of normal discharge; and in consequence of this, the battery is not subject to the great loss of efficiency,

urban service, I find, is the one installed by the Union Traction company of Philadelphia, Pa.

The road was originally a horse-car line, which ran as far as the depot at Pelham, a distance of 7.3 miles from the power house. Conduits and cables were installed for operating a number of cars which were supposed to be amply sufficient, The phenomenal increase in the travel, however, necessitated a large increase in the car service. In addition, the success of the line warranted its extension to Chestnut Hill, 2.3 miles farther. More recently the line has been extended down a long grade to Hillcrest avenue, and from Hillcrest avenue to the wheel pump on the Bethlehem pike, 1.6 miles farther, making the line 11.2 miles from the power house. With the first extension of the line to Chestnut Hill, the underground cable was also extended, but the drop in pressure over this long line made it imposible to run the requisite number of

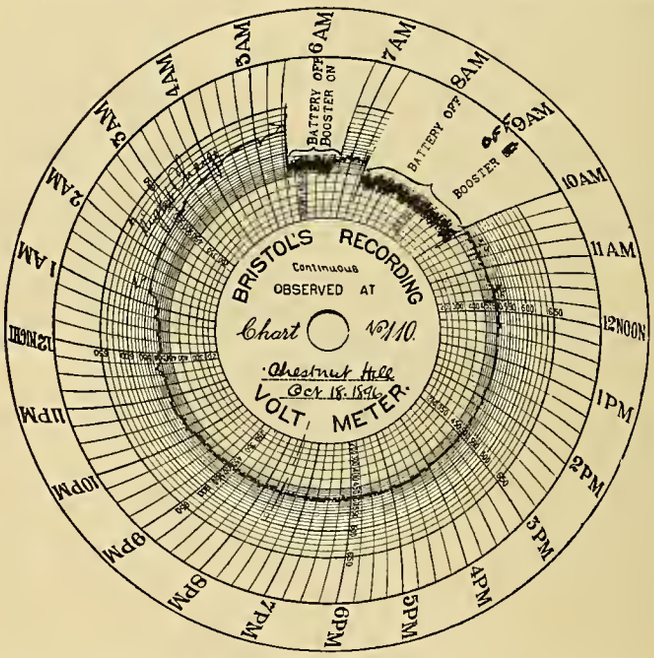


FIG. 6. APPLICATION OF THE STORAGE BATTERY TO ELECTRIC TRACTION.—VOLTMETER CHART FROM BATTERY HOUSE AFTER THE BATTERY WAS INSTALLED.

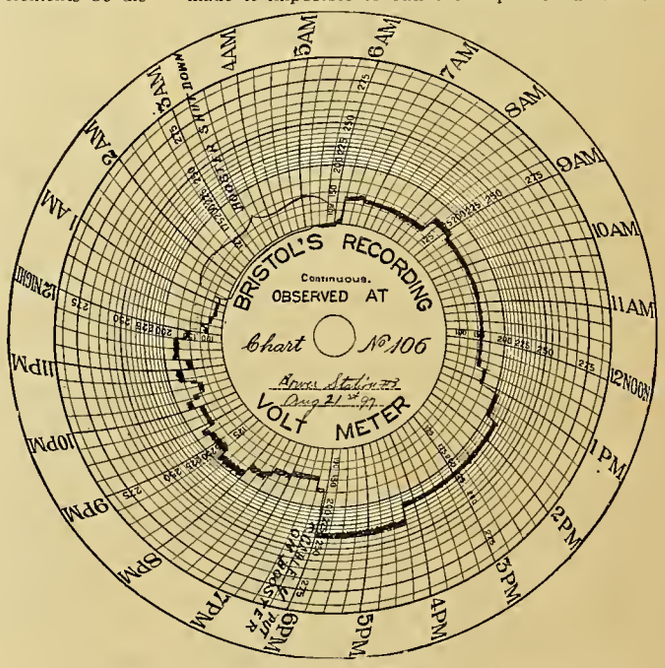


FIG. 7. APPLICATION AF THE STORAGE BATTERY TO ELECTRIC TRACTION.—BOOSTER VOLTMETER CHART.

cars, as the speed of a trolley car is approximately in the direct ratio to the applied electromotive force. The cables for feeding this section consisted of one cable extending to Chestnut Hill, one to Chelten avenue and one to Wayne Junction, about five miles from the station. All these cables were 1,000,000 circular mils, copper, rubber-covered and leaded, laid in terra-cotta ducts. The investment in feeders for this line had reached a point considerably above $100,000, not including the conduits. To have increased the cable system so as to have supplied this section properly would have required about 336,000 feet of 1,000,000 circular mils cable.

At $1.05 per foot, laid, this would amount to $352,800; deducting the value of cables which were already laid, and which are estimated at $79,000, we find that the extra cost for cables without conduits would have been $273,800. This figure is, of course, prohibitive.

In order that you may appreciate the condition of the line previous to the installation of the battery, I would call your attention to Fig. 3, which shows a recording voltmeter chart taken at Chestnut Hill, and to Fig. 4, which shows the pressure at station bus-bar on the same day. Three hundred and fifty volts was frequently touched. The average was a little over 400 volts, with 530 at bus-bar.

It was necessary, therefore, to furnish some means of keeping up the pressure. If a station had been built at that point, it would of necessity have been small and inefficient. From records taken at the main power house, it was found that it would be necessary to provide a station of about 750 kilowatts capacity; such a station would have cost about $85 per horse power, or a total of $85,000. A battery station, on the other hand, required but little real estate, and would be inexpensive to operate; its cost would be considerably less than a power station. In the Chestnut Hill plant the entire cost of real estate, battery and building was approximately $25,000; to this must be added the cost of a booster in the main power house. This required a 200 kilowatt generator, which, with its engine, would cost about $8,000. The total cost of battery and booster would therefore have been $33,000. In this installation, however, the company simply adapted a 300 kilowatt generator at the power house for this service, so that is was put to but little extra expense in the power house for adapting it to booster purposes. We find, therefore, that, deducting $33,000, the cost of the battery and booster, from $85,000, the cost of a station, the difference in first cost is $52,000 in favor of the battery. In addition to this, the company was put to an expense of a little over $13,000 for changes in the cable. In the estimates that follow I do not include any cost or interest on the cable, as the investment would have been about the same whether the company had built a station or installed a battery. It

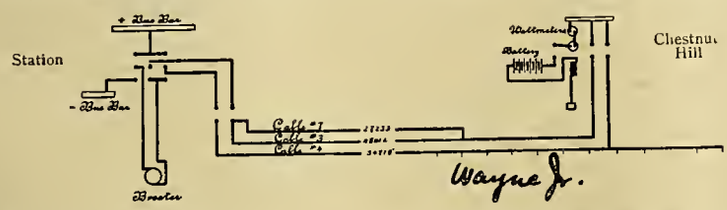


FIG. 5. APPLICATION OF THE STORAGE BATTERY TO ELECTRIC TRACTION.—DIAGRAM OF CHESTNUT HILL CABLES.

is very apparent, therefore, from the facts given, that on the score of the first cost, the battery was by far the cheapest installment which could have been made. In order that you may better understand the results which I propose to give in reference to the operation of this battery, I beg to describe the plant somewhat more in detail.

You will see by Fig. 5 that there are three cables concerned in this work, which are numbered No. 3, No. 4, and No. 7, all of 1,000,000 circular mils capacity. The lengths of these cables are shown in the diagram. Cable No. 4 is the only one which supplies the trolley wire direct; or, in other words, all the taps from the underground cable to the trolley wire are tapped on cable No. 4. This cable runs all the way from the bus-bar at the power house to the end of the line on the Reading pike at Chestnut Hill. It feeds in all about 12 miles of trolley wire. Cable No. 3 runs direct from the power house to the bus-bar at the battery house, as shown in the diagram. Cable No. 7 simply augments the capacity of cable No. 3.

In ordinary operation the current on cable No. 3 passes through the booster at the power house, by which the initial pressure is raised 150 volts more or less above the ordinary bus-bar pressure of 550 volts (Fig. 7). By this means the drop in the cable is overcome, so that the pressure at the battery house can be adjusted to a point where the battery varies but little to either side of the zero point; in other words, it charges and discharges continually, maintaining the load on cable No. 3 nearly constant, and consequently maintaining a constant electromotive force where the current passes out from the battery house through cable No. 4, as shown in Fig. 5. This cable (No. 4) is therefore fed from two points, namely, from the power house end at 550 volts and from the Chestnut Hill end at about 515 volts. As a consequence, the distribution along the line from Wayne Junction to the end at Chestnut Hill is comparatively uniform and is now very satisfactory.

At first the battery was allowed to discharge during the day about three times as much as it charged, making up the charge at night between the hours of 1 a. m. to 5 a. m. Later the amount of day discharge was decreased until the charge and discharge were about equal. The first gave a very even voltage of a little over 500. With the present method the voltage is somewhat more irregular, but the average is somewhat higher. By keeping the battery continually up to full charge, the night man has been dispensed with.

Fig. 6 is a copy of an average voltmeter chart after the battery was installed. When the load in the line is low, the current going over the cable No. 3 to the battery house divides at the bus-bar, one part supplying the necessities of the line, the other part charging the battery. When the demand on the line is heavy, the pressure drops a little at the battery house; all the current going over cable No. 3 will pass out over cable No. 4, and in addition the battery will discharge sufficiently to make up for the extra demand for current. This has the effect, as I have stated above, of keeping an almost constant load on cable No. 3. At times the load on cable No. 3 has become so heavy as to exceed the cable's capacity. At such time, by an arrangement of switches at the power house, shown in Fig. 5, cable No. 4 is put on the booster as well as cable No. 3. In doing this, the current through the booster is largely increased, but the pressure can be reduced from about 250 to 125 or 130 volts (see Fig. 7), and, in addition, better pressure is obtained at the Wayne Junction end of the section.

CORRESPONDENCE.

New York Notes.

New York, October 26.—The taking of evidence before the Supreme Court's Rapid Transit Commission has ceased, and a favorable decision is now hoped for. The report must be made by November 8th. It will probably come after election, when it will receive attention. If this report be favorable and is approved by the court, a bidder must be found for the franchise. It is said that the New York Construction company is ready to bid, and has ample capital. There is even hope that the whole line will be built in three or four years, but, as the Tribune says, the average New Yorker takes this with a grain of salt.

The State Railroad Commission has denied the application of citizens residing along Amsterdam avenue to reopen its decision approving the application of the Forty-second Street, Manhattanville and St. Nicholas Avenue Railroad company for permission to adopt the underground electric trolley system as a motive power. The Metropolitan Street Railway company, which operates its road on Amsterdam avenue, also has received permission to use the underground trolley system and has begun the work. Each company operates two tracks. Citizens along the avenue, fearing that the increased rate of speed under which the cars can be run with electric power would greatly endanger the lives of school children and citizens using that thoroughfare, petitioned the State Railroad Commission to reopen and amend its approval of a change of motive power on the Forty-second Street, Manhattanville and St. Nicholas Avenue road by compelling the company to use the tracks of the Metropolitan street railroad on Amsterdam avenue between Seventy-first and One-hundred-and-twenty-fifth streets. This would reduce the tracks from four to two, and would, the citizens argued, decrease by one-half the danger arising from the speedy operation of the cars. The members of the railroad commission considered this question at length and came to the conclusion that the commission has no authority in law to impose as a condition of its approval of a change of motive power that these two companies shall use the same set of tracks. While reaching this decision, however, the commission, in an opinion written by President Cole, says that the maintenance of four tracks upon Amsterdam avenue is a burden on the thoroughfare, and that the two companies involved should agree to use but one set of tracks. If they do no do so, the decision says, the local authorities have ample power to regulate the speed of the cars so that it can be kept down to that of a horse car.

Another trolley-car accident due to defective brakes is reported. A car of the Staten Island electric railway, while on its way from St. George to West Brighton, over the Brighton Heights division, ran away in Castleton avenue. It was going downhill when the trolley left the wire, and when Frank Dodell, the motorman, attempted to apply the brake the shoes would not hold. The car slid along the rails until it struck a switch, when it left the track and brought up suddenly. There were seven women and five men in the car and all were thrown from their seats, but no one was injured. All were badly frightened.

The Engineers' Club is well pleased with its new home on Fifth avenue, near Thirty-fifth street. The house was formerly the residence of Coleman Drayton and is large and elegant. Little alteration was required to fit it for a club. There are 14 sleeping rooms. The club's membership includes many prominent engineers and scientists of the country; nearly half of them are non-residents. Out of a total roster of 650, 355 come from New York and its vicinity. The club was organized February 3, 1888, and its house, until February of this year, was at No. 10 West Twenty-ninth street. The presidents have been James A. Burden, Charles Macdonald, J. F. Halloway, John Stanton and Charles H. Loring, the last being the present incumbent. The other officers and the chairmen of committees are: Vice-presidents, David Williams and John Thomson; treasurer, A. C. Rand; secretary, G. W. Bramwell; house committee, John C. Kafer; membership, Stephen W. Baldwin; library, G. W. Bramwell; auditing, George E. Weed.

M. S.

Canadian Intelligence.

Ottawa, October 25.—The Electric Railway company of Hull, Que., will erect a new stone car shed and station at Deschenes, similar to the one used at present, for the housing of additional rolling stock.

The city of Hamilton made a contract with its street railway company in 1892, by the terms of which, in addition to a high mileage rate, it agreed to pay a percentage on gross receipts, increasing from six per cent. upward. The bargain was a good one for the city, but not quite so good for the company; and now the latter is threatened with bankruptcy unless the terms are altered. It has petitioned the city for better terms, and, unless the request is granted, the owners of the electric railway will lose every cent invested in the enterprise.

An extensive system of electric railway from Montreal through the eastern townships is being projected. It will be known as the Montreal Southern Counties railway. It is the intention of the promoters of the enterprise to run the line through Chambly, where it will get the necessary power from the rapids. The proposed route embraces St. Johns, St. Alexandre, Bedford, East Stanbridge, Dunham, Cowansville, Sweetsbury, Knowlton, Bolton, Eastman, Magog, thence over Hatley mountain to North Hatley and Sherbrooke, via Capleton and Lennoxville.

At a meeting of the directors of the Montreal electric street railway a semi-annual dividend of four per cent. was declared, and, in addition, a bonus of one per cent. was given. The earnings of the company over and above all dividends, bonuses, expense of operation, etc., last year amounted to $102,106.79. It is expected that the company will transfer to the surplus account this year a sum which will exceed this considerably.

Mr. Kingsbury of Sydney, Australia, an electrical engineer and contractor, has been in this city, studying Canada's developments in electrical science. In Sydney, Mr. Kingsbury said, very few people realized the advancement which Canada has made, and he expressed his pleasure at the evidences of Canada's progress in electrical engineering, a matter in which Australia is comparatively young. The quality, finish and general character of Canadian street railway cars specially impressed him, and he thought a large business could be done with Australia in this line.

During the recent meeting of the British Association in Toronto, it transpired that the usefulness of the government magnetic observatory, in that city, had been destroyed by the operation of the electric railway service. The attention of the Dominion government was drawn to the facts, and a report on a new location for the observatory has been ordered. In all probability the site will be selected here and the observatory removed to Ottawa, which is free from the objections which destroyed its usefulness in Toronto.

It is said that the Lachine Rapids Hydraulic and Land company's power house, which was formally opened recently, is the largest electrical installation in the world outside of Niagara. At present the plant is incomplete. There will be 72 turbines which will one day be whirling under a head of 16 feet of water. There are 12 generators, at present, of 1,000 horse power each. The power, at present, is carried to the corner tower, whence it is conveyed by overhead lines on steel poles to a sub-station at the corner of McCord and Seminary streets, Montreal, for distribution. The company is now offering light 20 to 30 per cent. cheaper than existing rates, and power at half the cost of production by steam. The enormous dam and reservoir, in connection with the works, cost over $500,000.

A. V. W.

Northwestern Notations.

Minneapolis, October 25.—The plant of the Railway and Light company at Winona, Minn., has been inspected by Arthur Perry of Brookline, Mass., and Winthrop Coffin of Boston, both connected with the United Electric Securities company of Bostin, which owns about a half interest in the Winona plant. These gentlemen are on a tour of inspection of the 75 electric plants in which the Boston company is interested.

The master in chancery has made his report in the case of the Illinois Trust and Savings Bank of Chicago against the St. Cloud Water Power and Mill company of St. Cloud, Minn. He recommends the sale of the property at once, as the dam is going to ruin for lack of repairs, and the bondholders of the company are anxious to secure possession

of the property and make the necessary repairs. The value of the company's property is placed at $60,000, and the probable income of the company, if all the power can be rented, is placed at $12,000 per annum. This company furnishes power for operating the electric street railway system of St. Cloud.

Arthur Peabody contemplates putting in an electric light plant at Baldwin, Wis.

The Clarinda, Ia., Electric Light and Power company has bought the water power in that city and will put in a supplementary plant to use the water power.

Negotiations are pending between the Gas and Electric Light company and the Fox River Street Railway company of Green Bay, Wis., with a view to consolidating the two systems.

The Apple River Power company of New Richmond, Wis., is pushing work on its new power station at Somerset, and the electric machinery is being installed.

Boys of Sheboygan, Wis., have done considerable damage and caused no end of annoyance by climbing the poles and loosening the wires holding the arc lights and permitting them to fall to the ground. The live wires have laid on the ground all night, offering serious injury to anyone who might touch them.

J. H. Brown of Chicago, representing eastern capitalists, has secured an option on the water and electric light plant at Marshfield, Wis., from the Marshfield Light and Power company. Mr. Brown proposes to sell the plant to the city on easy terms.

The electric system of Huron, S. D., which has been shut down for a long time owing to the great expense of operating it, has been put in operation by Harry Sterling, who has utilized the famous Risdon artesian well for power.

In July, 1896, the mayor of Tacoma, Wash., had the electric wires of the Commercial Light company beyond Eleventh street cut, claiming the company had forfeited its franchise. The case was taken into court and carried to the Supreme Court, which has just handed down a decision to the effect that the franchise had not been forfeited, and the cutting of the wires was wrong.

The Butte, Mont., Street Railway company declined to accept a franchise granted that company for extending its system, and a new ordinance which was introduced in the council was defeated.

The council of Gladstone, Mich., has finally entered into contract with the Fort Wayne Electric corporation for an electric light plant. The bids were taken last March.

A franchise for electric lighting will be granted at Maquoketa, Ia., shortly.

Ortonville, Minn., is taking bids until November 2d for installing an electric lighting plant.

The new electric light plant at Eldon, Ia., has been completed and put in operation. C.

Owing to the general dissatisfaction of the public in Butte, Mont., with the arrangement made by the street railway company for planking between its tracks instead of paving, the company has asked the council for permission to build an electric line to Walkerville, and agrees to pave between the tracks this fall.

J. G. Robertson of St. Paul secured the contract for furnishing an electric light plant for Breckenridge, Minn., for $4,480.

Blabon & Son of Philadelphia have become interested in the proposed electric line between Oshkosh and Berlin, Wis., and will soon make a personal examination of the route. The necessary franchise over Oshkosh streets will be readily granted.

J. H. Marshall, who recently purchased the electric light plant at Roseau, Minn., has added new machinery and is improving the plant.

The council of Winona, Minn., will take bids for lighting the city by electricity and also by gas.

The city of Grand Forks, B. C., has let the contract to Contractor Davies to install an electric light and waterworks plant at a cost of $13,974.

James Leffel & Co. of Springfield, O., have been awarded the contract to furnish six 1,000 horse power water wheels for a $2,000,000 power plant to be established on the Big Hole River, near Butte, Mont., to furnish electric power for the smelters and other industries of Butte.

The Manawa Railway company of Council Bluffs, Ia., has secured an extension of its franchise for 50 years, and will make a number of extensive improvements.

The Hartford Electric company of Hartford, Wis., has been incorporated and will put in a plant at once. Power will be secured from the Hartford Plow Works.

The application of the Light, Heat and Power company at Winona, Minn., for a franchise was denied.

The Norway Electric company has been incorporated at Iron Mountain, Mich., to furnish electricity for lighting, heat and power for the towns in Dickinson county. The water power of the Sturgeon river in that county has been bought by the company.

Mr. Davis, representing the Electric Gas Light company of Boston, was dealing with St. Paul and Minneapolis merchants last week.

William de la Barre, chief engineer for the Twin City Rapid Transit company, states that although the work on the St. Anthony Falls power dam is progressing nicely, with 300 men now at work, it will not be in shape so that the railway company can take possession of the plant before January 1st. The cables and conduits are all in between St. Paul and Minneapolis, and work is now in progress in Minneapolis. The greater part of the machinery ordered from the General Electric company is now on the way to this city.

Allen Shewman of Green Bay, Wis., is an applicant for a franchise for an electric car line in Waupaca, Wis.

Boland & Smith will make a proposition to put in an electric light plant for Verndale, Minn.

It is announced that the Interurban electric line between Oshkosh, Wis., and Neenah is to be constructed at once.

The Chicago, Milwaukee and St. Paul Railway company has reopened its telegraph offices in Faribault, Minn., for night business.

The electric light system of Toledo, Ia., is to be extended to the Indian school at that place.

The council of Grand Forks, N. D., will secure estimates of cost for a municipal electric lighting system.

The general offices of the Minneapolis electric street railway will be moved from their present quarters to the Thirty-first street station as soon as the power from the new dam is ready. The present quarters, together with the engines which now furnish power, will probably be rented.

The Twin City Rapid Transit company has offered to the Postoffice Department a plan for carrying mail on all electric cars operated in St. Paul and Minneapolis. Two hundred mail boxes will be required. Each car will be a mail collector, the motorman stopping on a signal from one wishing to mail a letter. The plan is said to have worked excellently in Des Moines, Ia.

Twenty telegraph tickers are to be purchased for use of the fire-engine houses of the city, if the council agrees to the plan submitted by the fire chief and fire committee of Minneapolis. The object of the tickers is to inform the headquarters and other fire-houses that the various pieces of apparatus have returned from a fire and are ready for service. The firemen will go into the mysteries of telegraphy to a limited extent.

A St. Paul man, John J. Schoenleber, has invented a telephone system by means of which no central office is required, and a person is entirely protected from other interfering callers when conversing with a distant person. The instrument is operated as an ordinary telephone, with the addition of a dial switch which moves automatically and accomplishes the desired result. Mr. Schoenleber is proprietor of the Northwest Engineering company and has applied for letters patent on the invention.

Bids for the new fire-alarm apparatus for St. Paul have been opened by the Fire Commissioners' Board. The Gamewell company offers to install a manual central system for $9,940.25 and the old apparatus, or to install the automatic system for $7,990.25. The United States company offers to install the manual central system for $8,494, or the automatic for $7,511, allowing $500 for the old apparatus.

A resolution has been adopted by both bodies of the council, directing the city clerk of St. Paul to advertise for bids for a city electric lighting plant with a capacity of 400 arc lights, upon plans and specifications to be submitted by Gustave Willins, Jr., Joseph King and Assistant Electrical Inspector Varnum. C.

PERSONAL.

A. McNab Little has accepted a position as traveling salesman for the Western Electric company.

C. J. Sturgeon, manager of the electrical department of the Erie City Iron Works, Erie, Pa., called on his Chicago friends last week.

Thomas Doane, a prominent Boston civil engineer, who died last week, is said to have been the first American engineer to make use of the electric spark in blasting operations.

John I. Drake, secretary of the Hope Electric Appliance company of Providence, R. I., was in Chicago a few days ago in the interests of the new Hope switches, which attracted wide attention at the recent street railway convention.

Among the students recently admitted with high honors to the Ecole Polytechnique in Paris is a Becquerel. He enters on a scientific career in which his family has become famous. His great-grandfather, César Antoine Becquerel, who died in 1878 at the age of 90, was a noted investigator in the field of electrical research. His grandfather, Edmond Becquerel, was a professor of physics in the Ecole des Arts et Metiers, and did important work in optics and the study of light, and his father, Henri Becquerel, now a professor in the Ecole Polytechnique, is a well-known physicist. His maternal grandfather was also a professor of physics who taught in the Ecole Polytechnique 20 years.

Professor A. A. Michaelson, professor of physics at the University of Chicago, has been made a member of the international committee of weights and measures. This committee is composed of one member from each of the following-named nations: France, Germany, England, Russia, United States, Italy, Austria, Sweden, Switzerland, Spain, Portugal, Roumania and Norway. The membership in this body is for life and the elections occur only when death or resignation causes the vacancy. The vacant seat to which Professor Michaelson has been elected was caused by the death of Dr. B. F. Gould. The purpose of the committee is to propose and cause the adoption of a uniform system of weights and measures for the world.

The Western Electrician is in receipt of the following communication, dated October 22d: "Mr. John Needham of Manchester, England, senior partner in the firm of John Needham & Sons, who are largely engaged in the iron, steel, engineering and machine industries, and whose firm has handled a considerable quantity of American products, including wire rods, compressed steel shafting, bicycle tubes, screw bolts and nuts, labor-saving machine tools, bent timber for carriage building, manufactured spokes, wheel centers, etc., is in this country. Mr. Needham is desirous of extending his firm's business with America in connection with the iron, steel, machine and kindred trades. He is now at the Hotel Duquesne, Pittsburg, but is making visits to a number of other cities, among which are Cleveland, Youngstown, Philadelphia and Chicago. Mr. Needham will be back at the Windsor Hotel, New York, about the 10th of November, and any communication to him at that hotel will no doubt receive Mr. Needham's attention and consideration before he leaves for England. Mr. Needham expects to leave New York for England at the latter end of November or early in December."

Professor James M. Crafts, who has been elected president of the Massachusetts Institute of Technology, was graduated from the Lawrence Scientific School in 1859, and then spent six years in foreign study. Just before leaving Paris he was decorated by the French government with the medal of the Legion of Honor. In 1867, at the age of 28 years, Mr. Crafts was made professor of chemistry at Cornell, and two years later he was called to the Institute of Technology to take the place left vacant by the death of the head of the chemical department, Professor Storer. After two years in the institute Profesor Crafts was compelled by poor health to go abroad, and resigned his professorship. From 1871 to 1892 he divided his work between the laboratories of this country and France, laboring most of the time with Professor Fridel, in the Sorbonne. In 1892 he again returned to America, and began independent investigations in the laboratory of the Institute of Technology. He was elected a member of the corporation of the institute soon after his return. In the same year the position of professor of organic chemistry was offered to him, and accepted, and since that time he has been mainly occupied with the duties of that office.

ELECTRIC LIGHTING.

At the last meeting of the Chicago City Council the committee on gas, oil and electric lights was authorized to consider an order introduced by Alderman Kahler, to the effect that upon the termination of the present contract between the city of Chicago and the various gas companies for lighting the streets, the use of gas be discontinued, and that no further contracts be entered into by the city for the supply of gas for street lighting. The same order authorized the mayor and the commissioner of public works to advertise for bids for the proper lighting by electricity of such streets, as in the opinion of the council may be necessary, and that until such time as the city may hereafter decide to operate its own electric plant, and supply itself, such contracts shall be let to the lowest responsible bidders for supplying such light. This thrust at the gas trust has been contemplated by the aldermen, it is said, ever since the passage of the consolidated and frontage bill by the Legislature. The order was prefaced by a resolution, in which it was held that the lighting of the streets of Chicago by gas is inadequate to the requirements, while electricity was found to be not only practical, but efficient.

ELECTRIC RAILWAYS.

The work of building the Northwestern elevated railroad will probably again proceed within 10 days. Since the franchise for the construction of the road was granted there has been delay in carrying out its requirements. When the time limit was about to expire last December the company got an extension to January 1, 1898. Every effort will be made to complete the road within that time, but it is certain that another time extension will be necessary. Mr. Yerkes went to New York last Saturday, it is said, to secure funds to push the elevated work. He will undoubtedly return prepared to put a large force of men at work on the structure. Work was begun in January, 1896. The iron work is erected north of North avenue and the foundations laid along nearly the entire course of the seven miles of right-of-way.

For some time the Peoria and Pekin Union Railroad company, owning a belt line, has levied tribute on half a dozen steam railroad lines which do business in Peoria, for they are obliged to enter Peoria over the rails of the belt line. Not long since the Peoria and Pekin Traction company was organized, apparently to build an electric line between Peoria

and Pekin. The belt line management looked on the new enterprise as an ordinary trolley line to carry passengers and picnic parties between the two cities, but a few days ago it developed that the trolley line was a full-fledged competitor of the belt line. The Peoria and Pekin Traction company a few days ago bought a site for a union depot, paying $5,000 cash for it. Then several carloads of material for building a track for an electric and steam road were received by the traction company for the line to be built between Peoria and Pekin, and it was given out that the traction company had invited the Chicago, Peoria and St. Louis, the Big Four and the Peoria, Decatur and Evansville to use its line. If they make such arrangements the monopoly enjoyed by the belt line will be broken. The St. Louis, Peoria and Northern, now in course of construction, will use, it is said, the tracks of the traction company to enter Peoria, and the Santa Fe, which has a division terminating at Pekin, will enter Peoria in the same manner.

TELEPHONE.

The United States Circuit Court of Appeals has ordered a mandate to issue in the case of the Western Union Telegraph company against the American Bell Telephone company, in accordance with an opinion filed by the court in September, 1895. The case is one in which the Western Union Telegraph company demanded heavy damages on account of a contract, by the terms of which it claimed to be entitled to a percentage of the earnings of the subcompanies of the American Bell system. The case was brought in the United States Circuit Court and was referred to Judge Lowell as master. He heard the case, and prepared a report in favor of the Bell company. As soon as the Western Union's counsel ascertained this fact, he moved to have his bill dismissed. The Circuit Court entered a decree, allowing the bill to be dismissed, and the Bell company appealed to the Circuit Court of Appeals, which decided in favor of the appellant. Counsel for the Western Union then appealed to the United States Supreme Court for a writ of certiorari to review the proceedings of the court below, but the motion was denied on April 12th. The Circuit Court of Appeals sent notice to counsel that the mandate would issue on October 15th. The result is that the case now goes back to the Circuit Court, and the Western Union company must either allow a decree against it on the master's report, which would end the litigation, or go on and have a trial.

TELEGRAPH.

A telegraph convention is under consideration between India and China. The work of extending the telegraph across central Asia to Chinese Turkestan has been completed. Beginning outside the great wall, a line runs from Turfan all the way to Kashgar and Yarkhand, to the south of the Thian-Shan mountains, through Kashgaria, and is now being continued southward from Yarkhand to Shahidullah, the famous trading station on the northern side of the Karagorum pass, where it will be close to the Cashmere border and Indian lines. A second line runs for Shuchow, at the western extremity of the great wall, across the great desert of Gobi to Urumtsi, the administrative capital of the region, and to the capital of Ili-Kuldja. It runs close to the Russian frontier at two points. A connection of the first with the Indian lines will probably be arranged shortly, and then messages may be sent from London to all the towns in the heart of Chinese central Asia, and even to Pekin and the coast of China, by this route. But, like the Burmah route, it can never seriously compete with the cables until the Chinese character and modes of doing business are altered, or until the administration of the telegraphs is in European hands, for the delays owing to neglect and incompetency, even in China proper, are so great as to impair seriously their utility. But a line across the passes into Cashmere could not but be of great utility to trade between India and central Asia.

MISCELLANEOUS.

The farmers in Saxony are giving a great deal of attention to the use of electricity in agriculture, and it is finding much favor with them. Recent experiments in threshing by electricity have given surprisingly good results, so much so that in several sections of the country threshing will, it is said, hereafter be done by electric power exclusively.

Electricity has been decided upon as the motive power for the turrets on the new battleship Alabama, building at Cramp's, and the Illinois, building at Newport News, instead of hydraulic power, as the original plans called for. The sister ship Wisconsin, building on the Pacific coast, may also be fitted with the same mechanism. Contracts have been awarded by the Navy Department, by which each ship will be supplied with the proper gear for working the turrets at a cost not to exceed $10,000 for each vessel. This is considered by the Navy Department remarkably cheap, the former estimate having placed the amount as high as $75,000. The Brooklyn is fitted with electric gear, which works very well.

William E. Curtis, the Chicago Record correspondent, claims that there is a movement on foot to consolidate all the wire manufacturers of the United States under a single corporation, with a capital of $100,000,000. "To evade the anti-trust laws all, or nearly all, the wire industries will surrender their independence," he says, "and sell their plants to a new organization for cash at an appraised value, the money to be furnished by a syndicate of bankers in this city. As usual, Pierpont Morgan is the head of the scheme. When the new company is organized and all the properties are actually taken over, the trustees will receive subscriptions from their present owners for the preferred stock, which will carry a guaranteed seven per cent. cumulative dividend. That is, if the earnings of the new company are not sufficient to pay seven per cent. in any one year, the balance will be made up from future earnings before dividends are paid upon the common stock. If the subscriptions to the preferred stock exceed $50,000,000 an allotment will be made among the former owners of the mills on the basis of the value of their property. It is then proposed to issue $50,000,000 of common stock, which will be offered to the public, at a price to be based upon the first year's earnings. I understand that all the wire mills in Chicago and vicinity, those in Pittsburg and Cleveland, the Washburn-Moen properties in Massachusetts and all the other large companies are in the deal, and that experts are now visiting the several works to make appraisements."

TRADE NEWS.

The Pacific Electric company of La Crosse, Wis., has sold 500 of its Espersen shade lamps for shipment to Paris, France.

G. W. Chance, C. E., has opened an office at 915 and 916 Rothschild building, Philadelphia, as an engineer and technical adviser on steam and electric railways.

Baker & Co., the platinum refiners of Newark, N. J., have issued a neat booklet devoted to platinum and emphasizing their desire to purchase the crude ore at the highest market price.

W. H. McKinlock announces that John McKinlock has purchased the stock of the Metropolitan Electric company of Chicago, and that W. H. McKinlock and W. C. Camp will act as agents in the disposal of the stock and in taking other business in the line of electrical supplies. The big catalogue of the Metropolitan company is considered an important asset.

The Puritan Electric company, formerly of 150 Nassau street, New York, has removed its office to the Bowling Green building, 11 Broadway, New York, where it has increased facilities for handling the alternating enclosed arc lamp which it manufactures. This change was rendered necessary by the large increase in business which the company has received since the fall season commenced, and which has taxed its facilities of production to the utmost.

A "chain of vestibuled luxury" refers to the Pennsylvania Limited, the solid vestibule train of Pullman drawing room sleeping, dining, compartment, parlor smoking and library cars, and observation car, leaving Chicago daily at 5:30 p. m. Every link represents the luxury of modern hotel, club or home. An important link is the only observation car running to New York. Apply to H. R. Dering, assistant general passenger agent, 248 South Clark street, Chicago, for details.

George E. Pratt, the late secretary and general manager of the Hunt Air Brake company of Pittsburg, has severed his connection with that concern and entered the service of the Standard Air Brake company as special agent. Mr. Pratt is an earnest worker in the air-brake field, and as he thoroughly believes in air brakes, decided to continue in the business. It is certain that Mr. Wessels is surrounding himself with representative men in the various branches of the company's business.

Hugo Diemer, heretofore purchasing agent for the Bullock Electric Manufacturing company, and C. R. Hebble of Xenia, Ohio, have gone into business as electrical contractors. The partnership will be known by the name of Diemer & Hebble, with headquarters at 810 Neave building, Cincinnati, O. The gentlemen named will represent in their territory the Card Electric company of Mansfield, O., and the Shelby incandescent lamp. As both are graduates from technical institutions, and have had practical business experience, they hope to secure a fair share of the business in their territory.

BUSINESS.

Everyone desires to keep informed on Yukon, the Klondyke and Alaskan gold fields. Send 10 cents for large compendium of vast information and big color map to Hamilton Publishing company, Indianapolis, Ind.

"If you shovel coal, or buy it for someone else to shovel," say James L. Robertson & Sons of 204 Fulton street, New York, "send for our general catalogue." The firm makes grate bars which are claimed to have great efficiency and durability.

The Stromberg-Carlson Telephone Manufacturing company has recently duplicated some of its heavy machinery and added improved tools, which were made necessary by the rapidly increasing demand for its apparatus. The company is again able to fill all orders promptly.

Blotters illustrating the various styles of miniature lamps manufactured by the American Endoscopic company, Providence, R. I., have been issued. The high grade of miniature lamps manufactured by this concern is well known to the trade.

The American Electric Telephone company, 171-173 South Canal street, Chicago, has just issued a little pamphlet explaining the advantages gained by the use of bridging bell telephones on long lines, with valuable instructions for operators and telephone users in general. This pamphlet will be cheerfully sent to any interested person on request.

Going around Horseshoe Curve a magnificent view of the romantic Allegheny Mountains is obtained. The foliage in autumn attire presents a grand spectacle from the observation car on the Pennsylvania Limited, the only observation car running to New York. It leaves Chicago 5:30 p. m. every day, and crosses the Alleghenies after breakfast next morning. Full details for the asking. Address H. R. Dering, assistant general passenger agent, 248 South Clark street, Chicago.

The Electric Appliance company has recently increased its stock of clay tubes and bushings for electric wiring, and is now prepared to furnish promptly from Chicago stock clay tubes in any size, and of any length up to 24 inches, in unlimited quantities. The demand for wiring tubes has increased very much of late, and the clay tube seems to be in general favor on account of its economy and its power to stand rough handling. The breakage in clay tubes is considerably less than with the porcelain goods.

The Electric Arc Light company, 150 Nassau street, New York city, is working hard to secure its share of the holiday lighting trade. This well-known company, which manufactures the Pioneer inclosed arc lamp, claims that its lamp is particularly adapted for interior illumination, and has recently made the following sales: Abraham & Straus, Brooklyn, 300 lamps; James A. Hearn & Son, New York, 130 lamps; Callender, McAuslan & Troup company, Providence, 76 lamps; H. O'Neill & Co., New York; 76 lamps; Flint & Kent, Buffalo, 61 lamps; Jos. H. Bauland, Brooklyn, 47 lamps.

The Western Electric company's fan motors for desks, ceilings and walls are in preparation for the warm season of next year. The smooth running and economical operation of the Western Electric fans placed them at once in the front ranks of fan motors last season, and the difficulty was not to sell them, it is asserted, but to keep up with the orders. To avoid any disappointment to customers the company is making ample preparations to meet the rush of business next spring and summer. The Endolithic company of London has appointed the Western Electric company agent for its goods in the United States. This company manufactures all kinds of name-plates for dynamos, testing instruments, switchboards, furniture; in fact, for anything where a name-plate may be used. The Western Electric company is using these name-plates on its desk fans.

K. McLennan & Co., sole manufaturers of Gale's commutator compound, which will prevent sparking and cutting of commutators, put a high gloss on the commutator and not gum the brushes, stated recently: "The sales of the compound have increased more than three-fold since the first of September; at the present time the compound is regularly used by nearly every power plant and central station in the United States and Canada, and by a vast number of isolated plants. The reduction in price of the compound has helped to increase sales. We have recently established agencies in Norway, Sweden, England, France, Germany, and have in course of completion an agency in Japan. Nearly all of this foreign business is due to advertising, and we invite the readers of the Western Electrician who have not yet tried this compound to ask their supply house for a free sample stick, or to write to us at our office, Marquette building, Chicago."

The Mica Insulator company of 117 Lake street, Chicago, calls attention to its new M. I. C. insulator compound. The product is chiefly one of refined linseed oil, asphalt and rubber, with a character that has taken several years to form. The initials M. I. C. denote that the Mica Insulator company is behind it; standing as a guarantee that it is of a high grade. The M. I. C. compound is an enamel; black in color, and manufactured in four grades to suit all requirements. Each grade is an insulator, wet or dry; durable, elastic, even after baking. It does not contain carbon-bisulphide or any other objectionable materials. It is non-corrosive, stands high temperature, is impervious to moisture, has no offensive odor and can be reduced to any desired density of solution with turpentine or benzine. For the insulations and coatings of all parts of motors, generators, armatures, field magnets, wires, cables, transformers, overhead line constructions, arc lamps, switchboards, bare metal surfaces, and on cloth, paper, fuller board, etc., it is said to have no equal. Manufacturers of every variety of electrical apparatus, railway, telegraph, telephone, electric light and electric power companies, require a high-grade article of this kind, and, after the most

exhaustive tests and trials, the company stakes its reputation upon the new compound.

A representative of the Western Electrician recently visited the new factory of the Armorite Interior Conduit company of Pittsburg, and was surprised to note the rapid progress that had been made in locating and starting the new machinery that had been removed from the old factory on Brady street. The new Armorite factory is located close to the old gas-works, and is indeed situated in a model location for handling the raw material necessary to the production of Armorite, as well as having every shipping facility for disposing of the finished product. Anyone who saw the Armorite company's plant of a year ago in Detroit would be surprised to-day to note the large increase of factory and equipment that has been made necessary by the rapidly growing demand for this popular conduit. It would be noted, too, that much of the work that was done in Detroit by hand labor alone is now being carried out by special machinery. President James F. Cummings has shown a master hand in the matter of the production of special devices for facilitating the production of Armorite in large quantities, as well as having demonstrated high executive ability in equipping and placing in operation so extensive an establishment in so short a time. The Armorite factory, even with its increased plant, finds it hard to keep up with orders. Mr. Cummings states that the plant is running night and day, with orders still behind. As an instance of the phenomenal success of this institution, it may be said that word has just been received by the company from New York to the effect that the Armorite New York office has just closed a contract for the entire tubing of the big Empire building, Broadway. This order included 150,000 feet of Armorite. The Pittsburg factory is now running on this order, and the Armorite conduit is being shipped as it comes from the factory. President Cummings has left for New York, where he will remain for a few days.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued October 19, 1897.

591,855. Electrode for Storage Batteries. Herbert S. Lloyd, Philadelphia, Pa. Application filed March 15, 1897.

The electrode comprises a frame, two or more layers or strips formed of lead or an alloy thereof exteoding between the side bars of the frame, and a perforated leaden plate situated between the layers.

591,861. Electrical Current Interrupter. Henry W. Mather, Roseville, N. J. Application filed February 17, 1897.

A strip or ribboo for an electrical current ioterrupter stencil made of paper, having a portion of its fiber rendered structureless and formiog a hard mass about the remaining fibers.

591,869. Electric Transformer. Walter S. Moody, Lynn, Mass. Application filed May 20, 1897.

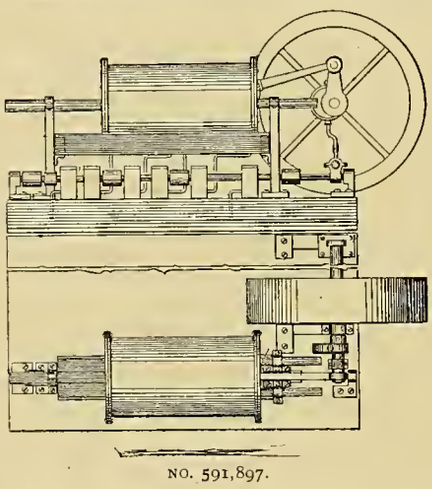
The insulatioo betweeo the primary and secondary windings is not applied directly, but is separated from the windiogs by air spaces, permitting a more ready absorption of the heat.

591,878. Mounting for Contact Shoes of Surface-contact Railways. William B. Potter, Schenectady, N. Y. Application filed June 19, 1897.

The third claim enumerates a mouoting for contact shoes of surface-contact railways, the combination of a support interposed between the shoe aud the truck, the support heiug substantially rigid with its attachment to the truck at one end, aod having a sliding attachment at the other, with a contact shoe and intermediate devices connectiog the contact shoe aod the support, such intermediate devices consisting of spriogs aod levers having limiting devices preveoting excessive play.

591,879. Electric Controller. Henry G. Reist, Schenectady, N. Y. Application filed March 9, 1897.

Io a controller for alternating curreot induction motors, the combination of a single switch for opening and closiog the primary circuit of the motor aod for reversiug the motor, and a separate regulating switch in the secoodary circuit of the motor.



NO. 591,897.

591,895. Electric Push-button. Elijah H. Stanley, Lake Geneva, Wis. Application filed December 18, 1896.

The contact strips are placed io recesses in the shell, with free portions projecting into a central concavity where the contact is made.

591,897. Electro-magnetic Engine. William M. Storm, New York, N. Y. Application filed December 8, 1896.

Patent is allowed for the combination with two helices arranged io an electric circuit, a maio shaft and a solenoid or piston gnided in the helices and coonected with the maio shaft, of mercury cups to which the terminals of the helices lead, and means actuated by the maio shaft, whereby the circuit is alternately closed io the helices through the mercury cups.

591,898. Damper for Electrical Measuring Instruments. Elihu Thomson, Swampscott, Mass. Application filed July 22, 1897.

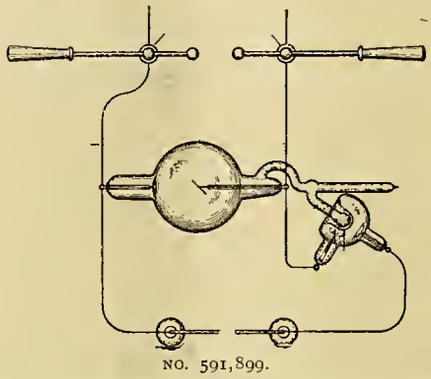
Mechanism coosisting of a moving member, a brake-piece and a coil inducing an alternatiog magnetic field acting upon the brake-piece to alteroately apply and release it.

591,899. Regulating Röntgen-ray Tubes. Elihu Thomson, Swampscott, Mass. Application filed August 4, 1897.

The device, intended for use with Crookes tubes, has an extension containiog a volatilizable substaoce or compound, a separable vacuum adjuster consisting of an exhausted auxiliary bulb haviog a portion fitted to the main tube for the traosfer of heat thereto, and contains terminals for the passage of electric discharges.

591,911. Electrically Operated Railway Gate. John S. Biggar, Chicago, Ill. Application filed July 29, 1895.

A pivoted gate-arm is provided with a bearing shaft; an electric motor is connected directly with the shaft and adapted to rotate or rock the same to operate the gate Electrically controlled means independent of the motor for holding the gate io a lowered position are also provided.



NO. 591,899.

591,995. Electrical Steering Gear. John D. Williamson, Jr., Philadelphia, Pa. Application filed May 15, 1894.

The first claim is given: Io an electric telemotor, the combioation of an electric generator, a curreot transmitter provided with numerous cootact points for regulatiog the exteot of movemeot of the object to be moved, a combioed curreot receiver and circuit interrupter electrically coonected with the contact points ou said transmitter and provided with a series of stationary contact points and with a series of movable contact points, one of the latter heiog a circuit-interrupting contact point connected by a wire with the generator, an electric motor electrically counected with said receiver aod ioterrupter, and meaos for mechanically operating said interrupter so as to cause its said circuit-interrupting contact point to interrupt the circuit to the motor and simultaneously establish a new circuit with the generator through said wire.

591,997. Insulated Electric Conductor and Apparatus for Making Same. James D. Bishop, New York, N. Y. Application filed June 7, 1897.

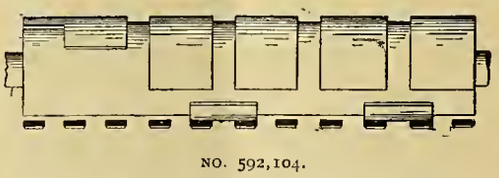
Apparatus for coveriog a conductor with a continuous tube of flexible insulating material, comprising feed devices for feediog the conductor and a web of insulating material simultaoeously to a flaring former to curl the material about the wire with overlapping edges, means for applying adhesive material to an edge of the flexible material to unite the overlapping edges, and a pressure device to force the overlappiog edges to adhere to ooe another.

592,016. Insulating Coupling for Electric Wire Conduits. Louis McCarthy, Boston, Mass. Application filed July 2, 1897.

The coupling comprises opposite connections made hollow or tubular for the reception of conducting wires aod an interposed insulator. At opposite sides of the insulator there are lateral passages to permit the wires to be withdrawn and passed aroood the exterior of the insulator.

592,025. Electric Conductor Wire Connector. Isaac Shultes, Martin, Mich. Application filed April 2, 1897.

A wire connector consisting of side pieces, a block provided with grooves io its under face, a plate spanning the space between the grooves, wedge pieces in the grooves with wires connected thereto.



NO. 592,104.

592,056. Electrical Traction. William Kingsland, Llandudno, England. Application filed March 5, 1897. Patented in England May 21, 1896.

The combioation with a continuous main electrical conductor aod sectional working conductors from which the motor-car directly collects the current of a number of sectioual auxiliary conductors, one such for every sectional workiog conductor, and through which auxiliary conductor the current is passed from the main to the sectioual working conductor, aud means whereby each sectional auxiliary conductor can be either connected to or disconnected froo the main conductor or from its corresponding sectional working cooductor.

592,097. Electrolytic Apparatus. Bernard Moebius and Gustav Nebel, New York, N. Y. Application filed July 6, 1897.

An endless silver-belt passes slowly through the vat containing the electrolyte, out of the vat and back into it. By mechanical means the surface of the belt is oiled when out of the bath and after the silver has been scraped off.

592,100. Automatic Magnetic Circuit Breaker. William M. Scott, Philadelphia, Pa. Application filed March 17, 1897.

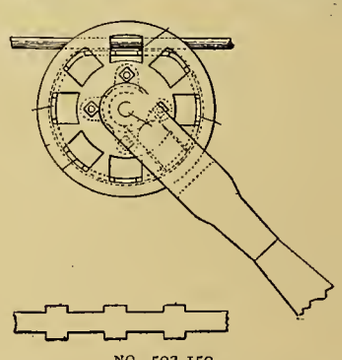
Ooe claim is quoted: In an automatic magnetic circuit breaker, the combination with a switch and contacts of a coil and a core vertically movable therein, said core adapted to be held within the coil during normal flow of current through the coil, but to fall by force of gravity upon an interrupted or predetermined below-normal flow, a rod attached to the movable core, a lever adapted to engage with the rod aod to be actuated by the rod, a cam adapted to engage with the said lever aod to be actuated by it, and a latch adapted to restrain the switch aod to be actuated by the cam upon the movemeot of the movable core communicated to it through the rod aod lever to release the switch.

592,104. Controller. Thorsten von Zweigbergk, Cleveland, Ohio. Application filed April 3, 1897.

The combination with an electric motor and a controller adapted to entirely opeo the circuit through the field of the motor, of means for short-circuiting the field while leaving the armature circuit open just after but not until after the controller has opened the circuit.

592,120. Combined Automatic Block and Signal System and Brake Automatic Appliance. James G. Pearce, Oakland, Cal. Application filed April 3, 1893.

The system includes a series of depression levers situated near the station, with electrical wires conuected therewith, an iodicator at the station from which the train is departing so conoected with a lever that its depression by the passing train operates an adjacent signal and returns the first-named signal to "safety," a second lever succeeding the first one and electrically connected with sigoals at the succeeding station, whereby the depression of the second lever indicates the approach of the train with the section, a series of check levers and electrical connections situated in groups between the stations for operating the train mechanism, a third lever at the departure station with electrical connections through the groups of levers, whereby the depression of the third lever by the passing train sets the mechanism of the groups throughout the section in condition to check the progress of an opposing train.



NO. 592,150.

592,123. Electric Switchboard. George W. Ribble, Hyattsville, Md. Application filed August 19, 1897.

A switch terminal or circuit-closing part is described.

592,150. Traveling Contact Device. Emil Lundqvist, Pittsburg, Pa. Application filed October 28, 1896.

A rolling contact wheel has recesses concentric with the axle of the wheel; there is an elastic continuous ring of suitable electric conducting material on the wheel and supported by the walls of the recesses; meaos are provided for pressing the wheel against the conductor, whereby when the wheel is forced against the conductor that part of the riog so pressed will be forced toward the center of the wheel while the remaining part of the ring is conformed to the recesses.

592,151. Electric Car Truck. Emil Lundqvist, Pittsburg, Pa. Application filed December 29, 1896.

The combination of two wheel axles, a driviog motor solely mounted on the truck frame between the axles, a motor shaft having a pinion on either end thereof, a motor casing; the pinions each engage a gear rotatively mounted in bearings in the extensions of the motor casing and loosely surrouoding the axles; the gears are connected to the axles through flexible joints consisting of sleeves loosely surrounding the axles, one end of each sleeve flexibly coupled to the axles and the other end similarly coupled to the gears.

592,225. Electrical Railway. Rudolph M. Hunter, Philadelphia, Pa. Application filed June 12, 1897.

The first claim reads: In an electric railway car, the combination of a series of electrically independent longitudinal conductors terminating in suitable couplings at each end of the car, an electric motor on the car having one terminal of its field magnets and armature electrically coooected with a portion of said longitudinal cooductors, and switch devices interposed between the motor and said longitudinal conductors for connecting at least one of the elements (the field magoets and armature) with either one of the series of said longitudinal conductors.

Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, NOVEMBER 6, 1897. No. 19

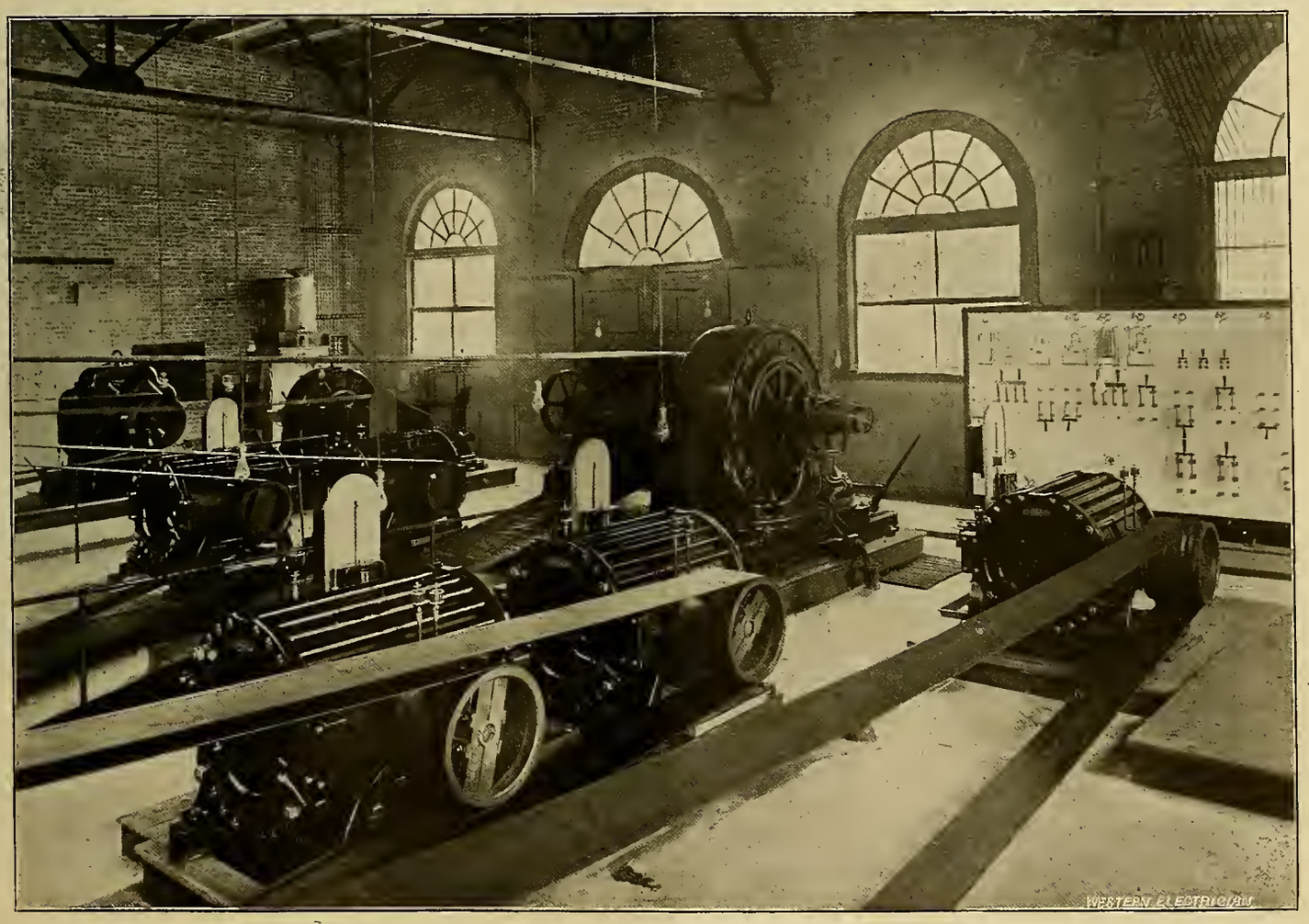
A North Side Central Station.

Among the smaller central station plants in Chicago, that of the Western Light and Power company in Lake View possesses considerable interest. The plant has recently been remodeled throughout, and it is sheltered in a new fire-proof building in the rear of the office at 660 Lincoln avenue. It contains two generators of alternating current of a recent two-phase type, a standard 500 volt power generator of direct current and several series arc machines of the familiar Thomson-Houston pattern. Incandescent lamps, direct current motors and series arc lamps distributed over a wide area on the North Side are supplied with current from this station. The company has no opposition in its territory and seems to be prosperous. Max Eichberg is president and treasurer of it, and his son, William N. Eichberg, is the superintendent. Louis A. Heile is the secretary.

Views taken in the engine and boiler rooms of the plant are herewith presented. The former, on this page, shows the dynamos and switchboard, while the latter, on page 258, depicts the new water-tube boilers. These boilers were made by the Standard Boiler company of Chicago, and have evaporative capacity rated at about 400 horse power each. They are fitted with Murphy automatic smokeless furnaces. There are also two National boilers of 100 horse power each. Lump coal is used, and no hand firing is required with the new boilers. A 1,600 horse power Excelsior feed-water heater is installed, and there are two Worthington boiler pumps. Water is obtained from the city mains. A fire wall separates the boiler and engine rooms, and the opening is provided with double iron doors. Exhaust steam is sold for heating purposes, an adjacent public school being supplied in this manner.

There are three engines driving dynamos, the connection being by direct belting. All are run non-condensing. The largest one is a Buckeye cross-compound engine of 700 horse power, which operates a large alternator and two arc dynamos. A 300 horse power simple Ball engine drives the power generator and the smaller alternator. A 100 horse power Ball engine is belted to three arc machines. All lubricating oil is collected and used over again, a gravity return system being installed for that purpose.

The new alternators were supplied by the Westinghouse company and are of the two-phase type. The larger one is of 375 kilowatts capacity, and the other is rated at 150 kilowatts. The exciters are belt-driven from the main armature shaft in each case. The 500 volt power generator is from the General Electric shops, and has a current capacity of 180 amperes. The five series arc dynamos are of the well-known Thomson-Houston type. Each is a fifty-lighter. A marble board carries the switches for arc, power and alternating circuits. The portion used for the plug switches of the arc circuits is not shown in the picture. Westinghouse instruments are used. The station is run continuously, day and night.



A NORTH SIDE CENTRAL STATION.—DYNAMO ROOM OF THE WESTERN LIGHT AND POWER COMPANY.

Receiver Asked for a Municipal Corporation.

Advocates of the municipal ownership idea will find food for reflection in the following press dispatch, dated at Cincinnati, October 23d: "The Post-Glover Electric company of Cincinnati filed a petition in the Common Pleas Court of Butler County at Hamilton, O., praying for the appointment of a receiver for the city of Hamilton. The petition alleges that the city, through corrupt mismanagement, has been brought to insolvency, that the funds have been depleted in the treasury, that the city cannot meet its obligations, and that the public schools will have to be closed, etc. The petitioners are creditors of the city of Hamilton for electrical machinery and supplies."

The Fire in Washington Street Tunnel.

On the evening of October 28th, about five o'clock, smoke was detected in the basements near the east end of the Washington street (Chicago) tunnel, which on investigation proved to be caused by an almost inaccessible fire. The former footpath under the South Branch, abandoned as such, has of late been utilized as a subway through which the electrical wires of various corporations and the city departments are run. There are five wooden cases extending the length of the tunnel, arranged one above the other. Commencing at the top there are city fire-alarm, telegraph, police and telephone wires; next below are the Western Union lines, including those of several of the steam railroad companies; the two lower cases were filled by the Chicago Telephone company.

In addition to these there are other electric wires, notably those of the Chicago Edison company, carrying current for arc lights and power, not in cases, but on insulators.

The smoke in the tunnel was so dense that it was impossible for the department to cope with the fire for some time, and it was only effectively attacked by approaching it from the west end of the tunnel, over all sorts of debris, broken boards, etc., the accumulation of several years. When the fire was finally extinguished a broken, tangled mass of wires and lead was all that remained of about 25 feet of the five wooden cases, with their hundreds of conductors.

The telephone company lost about 1,300 wires, while about 350 of its subscribers were cut off. The Western Union company lost four cables containing about 100 wires each. The city lost all of its connections for police and fire purposes, and the West Side was, for an hour and a half, turned back to the days before the present methods of fire protection. All the steam railroad companies on the West Side, whose wires run into the Western Union office on Jackson street, were badly crippled for

want of lines, and until near midnight their train service was anything but satisfactory. Temporary lines were run, and the various services were in fair working order by nightfall of Friday; but it will be some time before a perfect restoration of the various properties is secured.

The cause of the fire is a mystery which no one seems able to explain, but it can hardly be attributed to any source but electric current. The ruin was so complete when the fire was out that the place of its origin was impossible of location. Whether it was caused by a static spark followed by an arc, or was the result of a contact between a telephone wire and a trolley or an overhead arc wire, or simply a case of cross or grounding through poor insulation, it seems impossible to determine. All queries relative to a supposed origin give only this clue: "It was the other fellow's line that did the mischief, not ours; our lines never do anything wrong." Two of the companies whose wires go through the tunnel have proven a conclusive alibi. Their conductors were on insulators outside the boxes, and were totally unharmed. These companies are the Postal Telegraph company and the Chicago Edison company.

A meeting of several representatives of the various companies was held at City Electrician Ellicott's office on the day after the fire, looking to better protection of their conductors in the future. The city lines will at once be carried through the three tunnels under the river, so that in future its eggs will not be all in one basket. Suggestions were made by which the boxes will be removed and metal pipes, shelves or brackets substituted. Cost will be a secondary consideration.

This is the second time a fire has occurred in this tunnel. On a former occasion suspicion pointed to cable thieves who accidentally cut a live wire, but proof was wanting to point out the guilty one.

Diesel's Caloric Motor.

Hon. Frank H. Mason, United States consul-general at Frankfort, has forwarded to the State Department the following report as to the present condition of the experiments with the new Diesel motor.

On the 16th of June last, before the congress of German engineers at Cassel, Mr. Rudolf Diesel of Munich presented an elaborate scientific description and history of his new caloric motor, an invention which so eminent an authority as Prof. Schroeter endorses as a scientific triumph, and which, in the opinion of many expert engineers who attended and tested it in operation, marks an era in the progress of thermo-dynamics.

It is well known that the steam engine, after its inestimable work during the past century, and with all the improvements that it has undergone during recent years, is still, from a scientific standpoint, a wasteful and imperfect motor, which utilizes only a small percentage of the energy stored in the fuel which it consumes. Competent authorities estimate that an ordinary high-pressure steam engine utilizes only five per cent. of the value of its coal; a Corliss engine, of the best modern type, may reach an efficiency of eight per cent., while a triple-expansion engine of 1,000 horse power or more, with condenser and perfected cut-off, does not surpass 12 to 13 per cent., which is the maximum economic achievement of the steam engine at its present state of development. The remaining 87 or 88 per cent. of the fuel is wasted in imperfect combustion, the costly evaporation of water, by radiation at every point, and the heat that escapes with the exhaust steam after it has done its work.

Nearly a century ago, Sadi Carnot, the eminent French engineer, formulated and described in theory a perfect engine, and his specifications, embodied in text-books on thermo-dynamics, have formed the guide and goal of modern students of that science.

Fifteen years ago, Mr. Rudolf Diesel, then a young engineer at Munich, took up the task he has carried so far toward success as to produce a motor which, with oil or coal gas, utilizes from 28 to 30 per cent. of the fuel consumed. The problem has been to condense the essential elements of the motor; shorten the distance between the point where combustion takes place and the point where the generated energy is applied; to eliminate the costly and cumbrous evaporation of water, the waste of exhaust steam and the loss from condensation and radiation. Progress along this line had already developed the gas motor of various but substantially similar types, in all of which gas, mixed with atmospheric air, is exploded by ignition inside the cylinder. Within certain limitations the gas motor has been reasonably successful, especially for machines not exceeding 50 horse power, but it has the serious defect that the maximum expansive force is created as a sudden, explosive shock at the moment of ignition, causing a heavy momentary strain upon the machinery, followed by a decline of the expansive energy as the piston recedes at each successive stroke. This inherent defect of the gas engine pointed the way to a new and higher type of motor, in which boilers, coal bunkers and water should be eliminated, and the fuel burned within the cylinder; not by artificial ignition and explosion, but by spontaneous combustion and slow expansion, like the action of slowly burning smokeless powder upon a projectile in a long and closely rifled gun. It is because the new Diesel motor is believed to have met this fundamental requirement to a degree hitherto not attained by any other device, that its advent has been hailed as the beginning of a new chapter in the application of heat as a motive force to the requirements of industry.

After more than 10 years of study and experiment, Mr. Diesel published in 1893 a brochure in which he announced the cardinal principle upon which his invention is based: the ignition of fuel within the cylinder by means of heat spontaneously generated by mechanical compression of atmospheric air. His demonstration was so convincing that a combination was thereupon formed between the inventor and an important manufacturing machine firm at Augsburg, through which working models were built and the inventor supplied with means for further experiments.

The first practical Diesel motor built at Augsburg was one of 12 horse power, which ran with entire success until it was superseded by another of 20 horse power, improved in several details, and which, after eight months of constant service, is conceded to have fulfilled every claim and promise of its inventor.

Omitting all scientific technicalities, the new motor may be concisely described as a gas engine, somewhat similar in outward appearance to the ordinary type, but more compact and heavier, since the enormous pressure under which it operates requires great solidity and strength in all of its parts. The piston is long and of peculiar construction, having a countersunk recess in its outer face. The machine is so constructed that at the end of the outward stroke of the piston compressed air is admitted to the cylinder, and, at the same time, fuel, in the form of petroleum or coal gas, is ignited in the proper quantity. The piston, returning with the momentum of the fly-wheel, compresses the already partly condensed air to a density of 35 atmospheres, generating by such compression a temperature of about 1,200° F., sufficient to instantly ignite the fuel, which burns with a slow but expansive force, 500 pounds to the square inch, that drives the piston outward until the pressure is released by an opening valve at the end of the stroke.

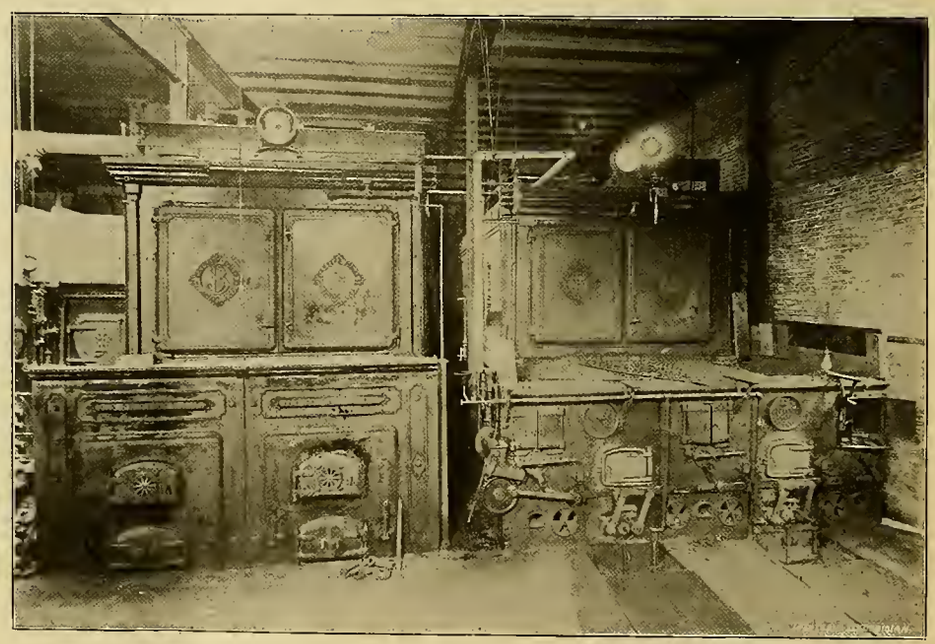
Thus far the energy has been applied to but one side of the piston, the forward end of the cylinder being open, as in the ordinary gas engine, but there is no apparent reason why the same process cannot be repeated in both ends of the cylinder, and it is confidently expected that a double-acting, 1,000 horse power Diesel motor will be the crowning feature of the German exhibit at the Paris Exposition of 1900. The cylinder is enclosed in a water jacket, which maintains a moderate temperature and wholly averts the deterioration of the interior working surfaces that is caused by the action of superheated steam. From this brief description it will be seen that Ericsson, in the construction of his engine, was on the right road, but he was not educated in the science of thermo-dynamics as it is understood to-day, and by applying the heat outside of the cylinder missed the essential point that could alone secure success.

From the verbal account of an eminent American engineer, who came specially to Germany for the purpose, and has lately spent some time at Augsburg, studying and testing the 20 horse power motor in operation there, it appears that the machine is compact, runs almost noiselessly and without shock by jar, and after eight months of service shows better results than when put in operation.

The Diesel motor has been patented in all countries where patents are granted for inventions, and the rights for France and Great Britain have been sold, while those for the United States are under negotiations which will probably be closed before this report may appear. In France important works are being established at Bar-le-Duc for the manufacture of this new motor. In England a motor of 250 horse power is being built for marine use, it being expected that the suppression of boilers, coal bunkers and condensing apparatus, combined with a motive force of 500 pounds per inch, will enable the new motor to revolutionize the machinery of torpedo boats and destroyers, if not ultimately of all sea-going war vessels, since its use will, among other advantages, allow watertight bulkheads, which must now be kept open for the passing of coal, to be kept closed indefinitely when a ship is in action or danger.

Thus far the fuel used has been mainly petroleum, but it has been demonstrated that common illuminating gas is a perfect material for this purpose, and the use of producer gas at American prices would, it is estimated, furnish power at half the cost of the steam generated with coal costing 80 cents per ton. At Nuremberg, Diesel motors are being built for street and railway cars, as well as for a motor tricycle, it having been demonstrated that for the latter purpose this device occupies but one-third of the space of an ordinary petroleum motor. The Otto Gas Engine company at Deutz is building a number of Diesel engines for use in Germany, and in May next all German makers of this motor will hold at Munich a joint exposition to exhibit what they may have accomplished toward its improvement.

So many inventions have been made, patented and announced as likely to supersede the steam engine, that claims like those now put forth for the Diesel motor will naturally be received with some incredulity. It is stated that it has been examined and approved by scientists like Lord Kelvin in Great Britain and by Prof. Schroeter, who, since the retirement of Dr. Zeuner, is the foremost authority on thermo-dynamics in Germany. Expert commissions from all civilized countries, includng notably Japan and Australia, have come to Augsburg to examine the new motor, and have added their testimony to the general verdict in its favor.



A NORTH SIDE CENTRAL STATION.—BOILERS FITTED WITH AUTOMATIC FURNACES.

American Institute of Electrical Engineers.

At a meeting of the Institute held in New York on October 27th a paper was presented by Richard Lamb on the "Development of Electric Cableways," describing the use of the electric motor for logging and canalboat haulage. It was fully illustrated by lantern slides. The paper was discussed by Messrs. Bijur, Henshaw, Keith, Leonard, Mailloux, Martin, Sachs and Wolcott. About 75 members and guests were present.

At the meeting of the executive committee in the afternoon the following-named associate members were elected: Abe Balsley, Terre Haute, Ind.; Herbert A. Balcome, Windsor, Conn.; Chas. T. Child, New York, N. Y.; William Goltz, Milwaukee, Wis.; M. E. Jones, Ithaca, N. Y.; Gifford Le Clear, Boston, Mass.; Silvanus P. Thompson, London, England; Geo. Henry Williams, Belfast, Ireland; James A. Wotton, Atlanta, Ga.

The following-named associate members were transferred to full membership: F. D. Sampson, Charlotte, N. C.; A. Davidson, Lima, Peru; Edward P. Decker, New York, N. Y.

Walter Dickey has been granted an electric light franchise at Ellsworth, Wis.

A Two-phase Installation in France.

The Northern Railway company of France has been quietly experimenting for some years on the transmission of electrical power. The first essays in that direction, dating back as far as 1894, between La Chapelle and Epinay, resulted most satisfactorily, a total industrial efficiency of 85 per cent. being attained, according to M. J. Laffargue, in La Nature.

The second series of experiments was carried out in 1896, and the installation then essayed is now in

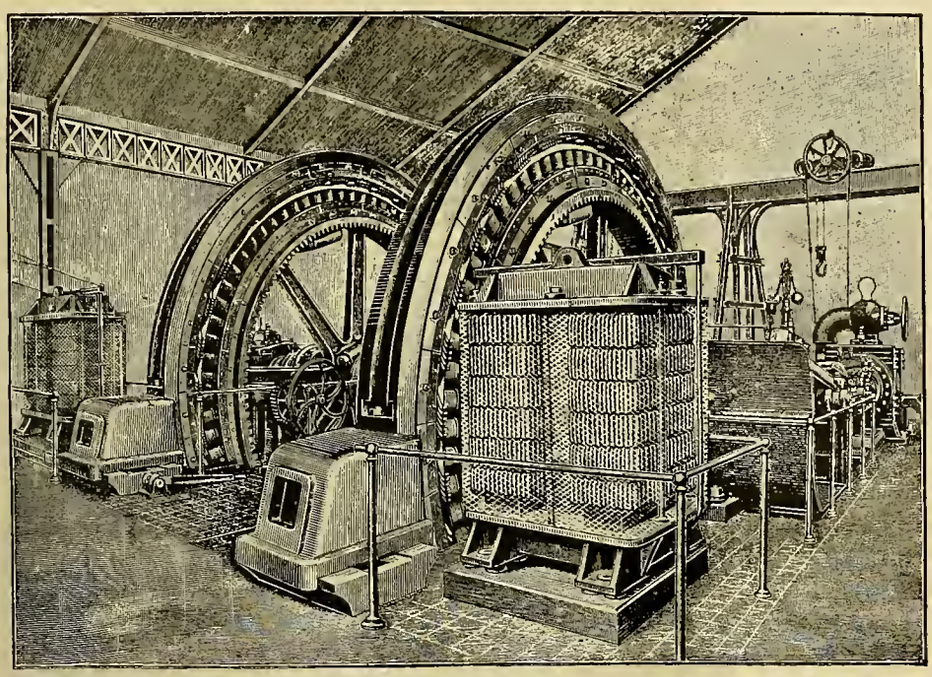


FIG. 1. A TWO PHASE INSTALLATION IN FRANCE.—ENGINE-DYNAMOS AT SAINT-OUEN-LES-DOCKS.

complete operation. The plant is located at Saint-Ouen-les-Docks, generating diphase currents which are transmitted to the passenger station of La Chapelle, at Paris, where the alternate currents are transformed and distributed as continuous current of variable potentials, as required by the several applications. The sub-station at La Chapelle supplies light and power to the freight depot, the offices, shops and warehouses of the roadway and those of the rolling stock. The station at Landy is furnished with current for charging accumulators for lighting the coaches, the freight sorting station of La Plaine, the stations of the Faubourg St. Denis

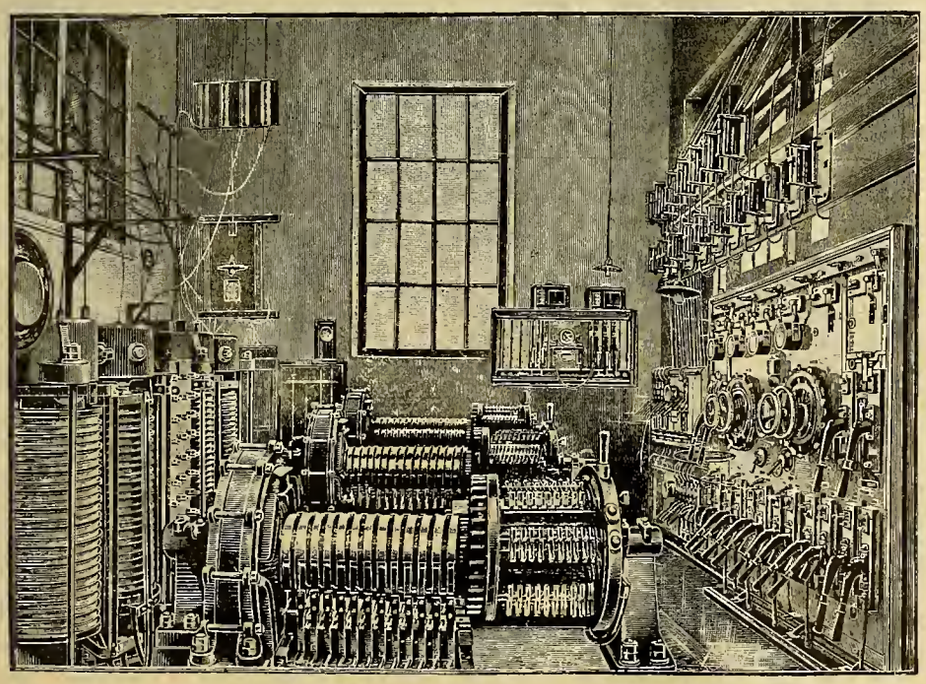


FIG. 2. A TWO-PHASE INSTALLATION IN FRANCE.—SUB STATION AT LA CHAPELLE.

and the light and power station of the Boulevard Barbes.

The statement has been made above that the currents employed are diphase. These are produced in two distinct circuits, and are so arranged that when one of these attains its maximum intensity the other is at the lowest—in fact, is nil—and the reverse order follows immediately. The two then have a difference of phase of 90°.

The central station of Saint-Ouen-les-Docks includes two alternators of the diphase form, of 250 kilowatts at 88 volts and at 1,420 amperes per circuit, with a frequency of 39 periods per second. These generators are direct-connected to condensing Corliss engines of 350 horse power, making 65 revolutions per minute. Fig. 1 gives an illustration of engines and alternators. The armature coils are fixed, and are constructed of bars of copper seated in iron in the interior periphery of a ring 6½ meters diameter. The windings are arranged to furnish the two circuits. The field is made up of a huge fly-wheel carrying 72 poles made up of sheet-iron, two millimeters in thickness, fastened by bolts. A portion of the current is made continuous by commutator rings, and is utilized as an exciter for the 72 electro-magnets. The two alternators may be coupled in quantity without difficulty. Their efficiencies are respectively 92.5 per cent. and 94.3 per cent.

Leaving the alternator, the two circuits carry the current at 88 volts, pass through the step-up transformer shown in Fig. 1, where the potential is raised to 6,000 volts. These transformers are made of three magnetic cores, the last being common to the two circuits thus formed. Upon each core are wound the low-tension primaries. The secondary windings (6,000 volts) are fixed above, a space sufficient to insure insulation between the two separating them. The efficiency of the transformers has shown as high as 96.7 per cent.

From St. Ouen an aerial line has four conductors of 12 wires each, making a total section of 21 square millimeters. This line, for a distance of about 3,000 meters, is on poles; thence it is placed underground, and is composed of two concentric cables, having two conductors 3,540 meters in length, with a sectional area of 30 millimeters. From these current is taken for the stations at Landy, La Chapelle, the Faubourg St. Denis and the Boulevard Barbès.

At La Chapelle the conductors pass through general switches and cut-outs, and thence to meters and self-induction regulators of tension. The current now enters the transformers and is reduced to 110 volts. The current from these windings is thence carried to a motor-generator which is actuated by a small synchronous motor. Two brushes now carry the current from the commutator, at 110 volts, to the various services for lighting and power.

Fig. 2 gives an interior view of the dynamo and engine room at the sub-station of La Chapelle, showing the two transformers of 45 kilowatts each, which reduce the tension from 6,000 to 110-165 volts. The motor-generators, three in number, have a capacity of transforming 300 amperes at that pressure; one of these instruments is a "spare," for emergencies. Fig 3 shows one of these in detail.

Experiments with the motor-generator at La Chapelle resulted in the satisfactory handling of 300 amperes at 130 volts for six consecutive hours. The self-induction spool permits of easy and perfect uniformity of regulation. Experimentally, the load has been raised to 350 amperes without a spark at the brushes.

The efficiencies of the different parts of the installation are as follows: Efficiency of the transformation of diphase into direct currents at La Chapelle, 91.2 per cent.; of the line (length 6½ kilometers), 92 per cent.; of the transformers at St. Ouen, 96.6 per cent.; and finally, the mean efficiency of the generator, 96 per cent. The industrial efficiency of the

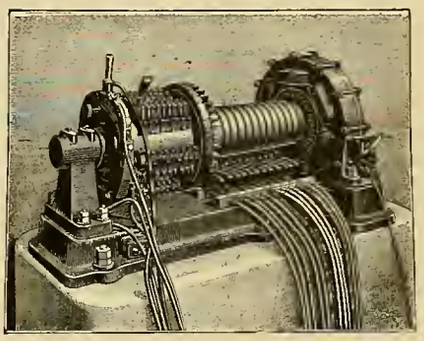


FIG 3. A TWO-PHASE INSTALLATION IN FRANCE —MOTOR-GENERATOR IN DETAIL.

transmission, comparing the utilizable continuous currents at La Chapelle with the power delivered from St. Ouen is 77.8 per cent., a most satisfactory result.

Astoria Hotel Plant.

In the new Astoria Hotel, New York is said to possess the "largest and most sumptuous structure of its kind in either hemisphere." Certainly the plant for heat, light and power is of exceptional size for a private installation. The description following is supplied by the Scientific American:

The boiler plant consists of Babcock & Wilcox boilers aggregating some 3,000 horse power. The electrical plant aggregates 2,200 horse power, and electricity is used for lighting, ventilating and elevator service. There are 18 elevators in the house, including those used for freight.

An idea of the size of the electric lighting installation may be gathered from the fact that it includes 7,500 outlets which serve a total of 15,000 lights. The circuit wiring has been arranged with the object of individualizing each floor or portion of floor, and in some cases even single rooms. The switchboard is 50 feet long, and the power and lighting circuits are separately provided for. The generating plant has a capacity of 1,300 kilowatts. It is supplemented by a storage battery giving sufficient reserve to cover all possible emergencies. The generators alone can carry a load equivalent to from 20,000 to 25,000 16 candle power lights, and the storage battery increases the capacity about 50 per cent. The plant includes four Corliss engines, each direct-connected to a 250 kilowatt generator, and two engines driving two 100 kilowatt generators. One-third of the current generated is used to drive the electric motors, which operate the elevators, ventilators, laundry machinery and other plant in various parts of the building.

The equipment of electric signals, annunciator bells, telephones, etc., is one of the most, if not the most, elaborate in the world. The circuits have been designed with the idea of subdividing each floor into "districts," each of which has its local station. These stations are "interconnected" by trunk lines, and they are also connected with the main central or operating station, which is located on the mezzanine floor. Here the trunk lines converge from all directions. At each floor the lines also converge to a local or floor office. At each local office there are several hundred lines, and the number of lines that converge at the main central office aggregates some 4,000. The connections are such that a call from any room is recorded at both the local floor office and the main central station on the mezzanine floor.

New Projects at Niagara.

An association to be known as the Canadian Niagara Power League was recently organized in Niagara Falls, Ont., the object of which seems to be to inspire a national loyalty in the development of the power of the falls and rapids on the Canadian side of the Niagara River. It is announced that the organization will be purely non-political and will be made up of prominent men of all parties. It will organize branches in many cities and villages throughout the Dominion. The men back of the association announce that every possible leverage will be brought to bear for the attainment of the league's object—the development of Niagara's power on the Canadian side. They point to the fact that the power of the province of Quebec is being developed with profit; also that the power of the Niagara on the New York state side has been developed to a considerable degree, but that the Canadian side is barren of factories which might be obtained were the power available at their command. They feel that the Niagara power question is of importance to the whole Dominion, but that the question is not properly understood. For this reason they will take steps to inform all interested on the different phases of the situation. Whether they will be friendly to the Canadian Niagara Power Company, which holds exclusive privileges in Queen Victoria Park on the Canadian side, is not yet clear. A circular letter is being mailed, and all public-spirited men will be asked to subscribe, with the idea of bringing the advantages of Canadian Niagara power to the attention of the world.

The very latest power project at Niagara Falls is one that advocates the construction of a tunnel on the New York state side from a point at the head of the rapids to the Devil's Hole, or thereabouts. This tunnel would not follow the course of the river, but, on the contrary, would be sunk at a depth of about 200 feet across the neck of land formed by the river turning at a right angle at the whirlpool. The distance is about 10,000 feet, it is estimated, and the head that would be available is about 83 feet. The tunnel would have to start and end on the property of the Niagara Falls and Lewiston railway, better known as the Gorge road. As yet the project has not assumed definite form, but the promoters are active in a quiet effort to enlist the attention of capitalists in the idea. The length of the tunnel of the Niagara Falls Power company is about 7,000 feet, and this work occupied years in completion. The estimated length of the proposed tunnel at the rapids is 3,000 feet greater than that of the tunnel above referred to, and it would, therefore, occupy a much longer time to finish it, while it would also entail an enormous expenditure. The amount of power to be made available by such a tunnel as that proposed would, of course, depend largely on the size of the tunnel, no dimensions of which have as yet been given by the promoters. The Devil's Hole, the point referred to, is midway between the Falls and Lewiston. It takes its name from an excavation in the cliff, and is on the line of the Gorge road.

Audibility of Thunder.

[From the Pittsburg Dispatch.]

In connection with the proposal to establish a number of government stations for reporting the phenomena of thunderstorms, it is stated that while lightning may be seen and its illumination of clouds and mist may be recognized when it is even 200 miles distant, thunder is rarely audible 10 miles. The thunder from very distant storms, therefore, seldom reaches the ear. Hence, if every thunderstorm has to be recorded, a large number of stations will be needed; probably one for every 25 square miles would not be too many. A few stations would suffice, at least for the night time, for the reporting of the direction and movement of every case of distant lightning.

The reason of the great uncertainty in the audibility of thunder is not hard to understand. It depends, not merely on the initial intensity of the crash, but quite as much on the surroundings of the observer, even as in the quiet country one will observe feeble sounds that escape the ear in a noisy city. Perhaps the most curious and important condition of audibility is that the thunder wave of sound shall not be refracted or reflected by the layers of warm and cold air between the observer and the lightning or by the layers of wind, swift above and slow below, so as to entirely pass over or around the observer. Sound, in its wave-like progress obliquely through layers of air of different densities, is subject to refraction, and this refraction may occur at any time and place. Thus, observers at the topmast of a ship frequently hear fog whistles that are inaudible at sea level; those on hilltops hear thunder that cannot be heard in the valley; those in front of an obstacle hear sounds inaudible to those behind it.

The rolling of thunder, like that of a distant cannonade, may be largely due to special reflections and refractions of sound. Again, the greater velocity of the air at considerable altitude above the ground distorts the sound wave and shortens the limit of audibility to the leeward, while increasing it to the windward.

A Modern 230-volt English Central Station.

Bradford, in 1889, was the first borough in the United Kingdom to possess an electric lighting station. Continuous current was adopted from the first, but in those early days the supply was by two wires at 100 volts. The generating plant consisted of three Lancashire boilers, each of 180 horse power, three 150 indicated horse power steam engines, working at 120 pounds pressure, one by Marshall, Sons & Co., Gainesborough, and the other two by Willans & Robinson. These engines were direct-coupled to Siemens dynamos, developing 120 electrical horse power (90 kilowatts) each. About 10 miles of cable were put down, including four feeders, and this work was entrusted to Siemens Bros. & Co. The small number of consumers connected to the mains at this time necessitated the plant being run only for a few hours before midnight, as there were no motors in use to demand a day load. Nevertheless steady progress was made during the first few months, and so satisfied were the consumers with the light and the price charged for the current (5d. per unit), that others soon began to appreciate its advantages, and in 1890 applications for light were so numerous that the works had to be extended at a cost of an additional £30,000. A portion of this extension consisted of a secondary battery of 70 cells, of 1,000 ampere-hours' capacity.

By the end of the year 1891 the number of consumers had increased considerably, as may be gathered from the fact that over 10 miles of additional mains had been laid, and the number of British Board of Trade units sold amounted to 239,361, the total cost per unit sold being 2.47d. The supply was now uninterrupted throughout the 24 hours, and it may be mentioned that a few electric motors had been connected during the year. In 1892 the year's work realized a profit of £1,385, and in the following year the rapidly increasing area of the supply necessitated a change from the two-wire to the three-wire system, and a sum of £30,000 was obtained for the extensions which were carried out at this time. In 1894 additional plant at the power station was urgently needed. The new boilers were of the marine type, and were fitted with the Ellis and Eaves system of fan draught, similar to that in the boiler house of the new station just opened. Two Willans-Siemens 300 horse power sets were also added to the equipment. In the year 1895 the full capacity of the plant was 18 per cent. below the maximum possible demand, and the committee in charge saw that the interests of the electricity department would be seriously handicapped in the event of the breakdown of any engine or dynamo, as there was no "stand-by" plant to rely upon in case of emergency. It was therefore determined to build a new station in a situation more suited to future extensions than that of the present one, and, a favorable site having been chosen, borrowing powers were obtained for another £40,000, and work upon the new station was proceeded with in the early part of 1896.

It is worthy of mention that about this time the pressure of supply was raised from 115 volts to 230 volts on each section of the mains. This period is also notable for the introduction of the free supply of lamps to consumers, and for the reduction of motor power to 2½d. per unit. The practice of hiring out motors and are lamps was also commenced. So successful were these various changes in the conditions of supply that the demand for current and revenue therefrom both rapidly increased, showing both a larger and steadier demand; while, in less than six months over 40 additional motors were added to those already upon the circuits, bringing up the demand for motive power in the daytime to 300 horse power. At the present time the motor load is no less than 642 horse power.

The new power station is capable of holding plant aggregating several thousands of horse power, and affording ample provision for rapid and great extensions in the future. As will be seen in Fig. 1, which shows the interior of the new engine room, the actual plant already erected covers but a small fraction of available floor space, while foundations have been prepared for new sets that may shortly be needed. The rear part of the room is of a temporary character, and opens on to a large piece of waste ground which is held in reserve for extensions of the machinery room and boiler house.

The building is an imposing stone structure situated in Valley Road. In the front part are offices and storerooms, the main portion of the rear forming a lofty and spacious engine room, while the boiler house forms a wing, the floor of which is considerably lower than the main floor. In the basement of the front part are the condenser and pumps.

The engine room measures at present 85 feet long, and has a width of 61 feet, this entire width being carried in one span by the roof. The height of the side walls to the springing of the roof girders is 28 feet. A hand crane extends the entire width of the room, and is capable of handling 12 tons. The floor of this room is laid in ornamental tilework on concrete arches, and steel joists, there being ample space provided below the floor, in the way of tunnels, for inspection of the machinery foundations and for conveying cables from the dynamos to the switchboard. The switchboard, which was built by G. A. Steinthal of Bradford, is supported on steel girders carried on round, cast-iron columns. There are two central large panels and 10 smaller side panels above the platform, and below the platform there are 10 panels, on which are fixed Thomson recording meters, these being in the feeder circuits. The switchboard equipment comprises two very large Weston quadrant station voltmeters, Kelvin multicellular check voltmeters, double-break knife switches, and automatic circuit breakers.

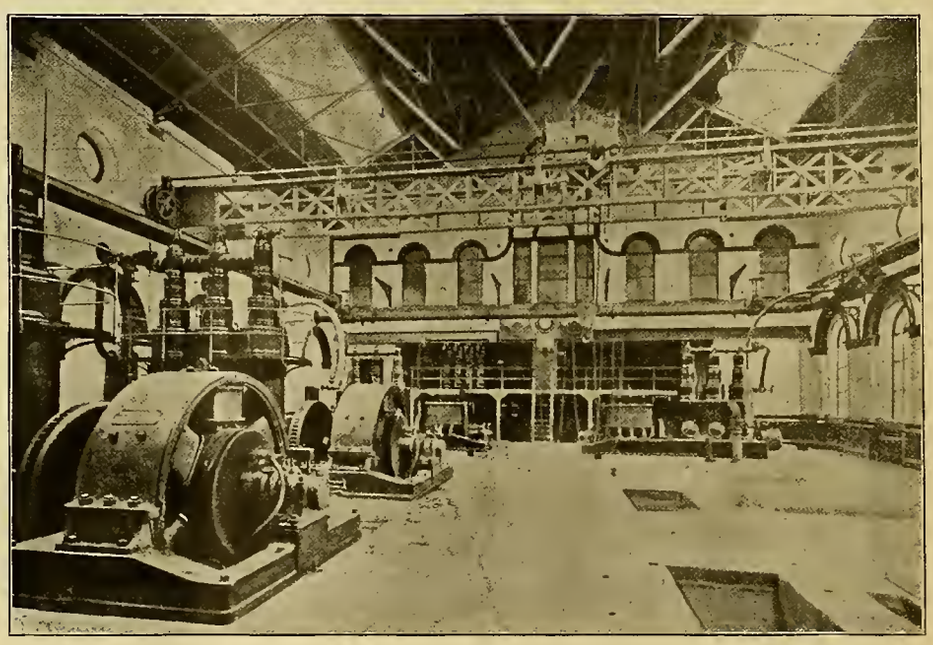


FIG. 1. A MODERN 230-VOLT ENGLISH CENTRAL STATION.—ENGINE ROOM.

A steam ring main entirely surrounds the engine room at a height of several feet above the floor level, and will supply steam to the 12 generating sets for which the room is designed. The main ring is of lap-welded steel tube, 10 inches in bore and three-eighths inch thickness, with cast-iron T-pieces at the engine and boiler branches. The branch pipes are of solid drawn copper, of six inches diameter and one-fifth inch thickness and of four inches diameter and one-sixth inch thickness. The exhaust ring is carried under the floor, and is of cast-iron, two inches in diameter, with 14 inch and 18 inch branches.

Four generating sets have already been erected. Two of these are 300 horse power Willans-Siemens sets that have been transferred from the old station. The engines are three-crank triple-expansion engines, and are each capable of developing 360 horse power when running at 350 revolutions per minute under steam at 200 pounds pressure. They are direct-coupled to two continuous current two-pole drum-wound dynamos, built by Siemens Bros. & Co., each capable of an output of 750 amperes at 250 volts. The other two generating sets also consist of Willans engines direct-coupled to Siemens dynamos, but are each twice the capacity of the former. The engines are three-crank triple-expansion engines, fitted with Willans & Robinson's automatic expansion gear,

and are each capable of developing 600 horse power at a speed of 300 revolutions per minute. The dynamos are six-pole drum-wound machines, with interconnections for two sets of brushes. The output of each machine is 750 amperes at 500 volts. The engines are designed for condenser working, but provision has been made for either condensing or non-condensing.

The boiler house is a spacious but as yet scantily occupied apartment, the two compact boilers that have already been erected requiring quite a small fraction of the available space. The dimensions are

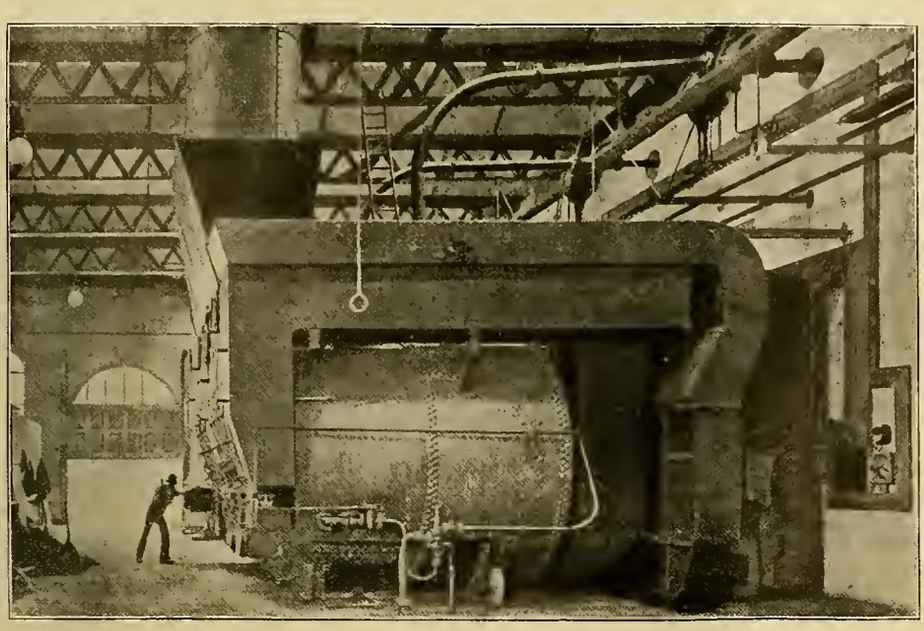


FIG 2. A MODERN 230-VOLT ENGLISH CENTRAL STATION.—BOILER ROOM ARRANGEMENT.

105 feet long, 48 feet wide and 23 feet in height. In the roof are a number of ventilators for the escape of steam, etc. Space is provided for seven boilers, of the same type as the two now erected. These are marine boilers, built by John Brown & Co. of Sheffield, and fitted with the Ellis and Eaves system of induced fan draught. The boilers are stoked by hand with bituminous nuts, costing from 5s. to 7s. per ton. Coal is brought in carts, and, after being weighed in the station yard, is run up an inclined way and tipped into the bunkers. One of these bunkers, together with the two boilers, may be seen in Fig. 2.

A striking feature of the boiler plant is the high draught under which it works, the usual draught being rather over four inches of water. This draught is developed by means of electrically driven centrifugal fans placed in a late part of the flues. There are two furnaces in each boiler, and the gases pass independently from each through the internal flues and then through an exterior flue to the fan chamber. In this exterior flue the hot gases pass

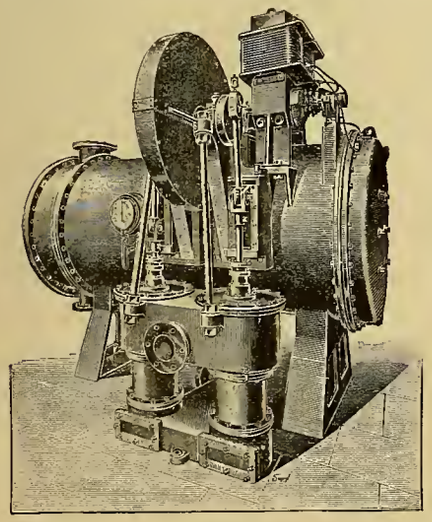


FIG. 3. A MODERN 230-VOLT ENGLISH CENTRAL STATION.—SURFACE CONDENSER AND ELECTRICALLY DRIVEN AIR PUMPS.

between a number of tubes, arranged in a stack between tube-plates, through which the air passes and is heated on its way to the grate. The warmed air is discharged into the fireplace both above and below the grate and chiefly around the space just inside the fire door. After passing through the centrifugal fan, the furnace gases pass upward to an exterior flue which conducts them to the front of the boiler range, where they are discharged into the smokestack. The fan draught apparatus is driven by two electric motors, each of 21 horse power, built by Ernst Scott & Mountain of Newcastle. The motors are direct-coupled to the fans. Each boiler normally develops 600 horse power, but can be readily forced up to 800 horse power. The boiler plant is equipped with injectors and electrically driven feed pumps, and is connected on occasion with duplicate testing tanks, each of 1,000 gallons capacity.

The condensing and water-cooling plants are admirably arranged. In the basement beneath the offices are to be found a marine surface condenser and duplicate air and circulating pumps. The surface condensing plant (Fig. 3) is capable of condensing 30,000 pounds of steam per hour with a vacuum of 26 inches. The temperature of the steam is about 200° F., and the temperature of the cooling circulating water is about 60° F. The condenser is circular in form, the outer casing being fitted with two large feet for supporting the condenser and is also fitted with two strong rolled brass tube plates. The tubes have a total surface of 2,500 square feet, and each tube has an external diameter of three-fourths inch of No. 18 (British wire gauge) radial thickness, secured by gun-metal ferrules screwed into the brass plates with tape packing, so arranged that the tubes cannot slack back. The condenser is fitted with manholes for cleaning purposes. The inlet for the exhaust steam is placed on the top of the condenser midway between the ends. The condenser has been tested to 30 pounds per square inch water pressure.

The two air pumps are arranged side by side and bolted together in the center. The air pumps work with a vertical motion and are driven by an electric motor geared to a crank shaft common to the two pumps. The air-pump casting is of cast-iron, with gun-metal liners and seatings, the whole arrangement working practically noiselessly. The electric motor is provided with a resistance in the main circuit and gear for regulating the speed. The motor is shunt-wound for a working pressure of 250 volts. The gearing from the motor spindle to the pump crank shaft consists of spur wheels, the teeth of which are accurately machined in order to obviate as far as possible any noise in working. The circulating pumps are capable of discharging 2,500 gallons of water per minute at about 350 revolutions, and are driven direct by an electric motor. The hot well is of steel plate six feet by six feet by six feet, stayed together by internal stays, and is provided with a long gauge glass on the outside.

Cooling plant for the circulating water is provided in the waste ground at the rear of the building. The hot water is discharged into a long cast-iron chute, whence it descends to a series of tanks, the whole arrangement providing a considerable amount of cooling surface.

The new generating station is connected to the old station and to the original feeding points by a complete system of feeders and pilot wires, by means of which the two stations work conjointly on to the same network of distributors. There are five new cable lines, each 1,030 yards in length and 1.5 square inches sectional area. The cables were made by the British Insulated Wire company of Prescot, and are protected with a solid lead tube of a radial thickness of one-eighth of an inch. A further protection consists of two ribbons of mild sheet-steel, wound one over the other so that the convolutions of the upper layer overlap those portions of the cable left unprotected by the lower layer. One thousand and fifty yards of three-core pilot wire is also laid with the above cable, to which the registering instruments on the switchboard are connected.

These facts and the illustrations are taken from the London Electrician.

A Great Light for Mariners.

Alluding to the experiments ordered to be conducted at Tompkinsville, Staten Island, by the Lighthouse Board, a Washington correspondent says that important results are expected, which will in all probability materially diminish the menaces to navigation along the New Jersey coast and prove a great step toward rendering impossible a recurrence of last winter's disasters which had their climax in the running on shore of the American line steamer St. Louis and the narrow escape of other great transatlantic ships. The tests are intended to prepare for installation at Barnegat the splendid revolving lens exhibited at the World's Fair, which was subsequently purchased by this government for $10,000, and has since been allowed to remain idle. At Tompkinsville it is to be at once erected in a room, and the electric light apparatus, with which its illumination is supplied, will be run continuously, in order to study its trustworthiness and endurance, and to make the lightkeepers familiar with its care. A closed room is essential for the conduct of these experiments, as otherwise all neighboring lights would be invisible to mariners on account of the blinding glare it diffuses.

The light now marking Barnegat is of a high order compared with other American coast safeguards, and is visible in clear weather along a horizon 22 miles distant, that limit being fixed by its height above sea level, rather than by the brilliancy of its lamp. But with the lens now to be tried, the intensity is so great that although the lighthouse itself could not be seen in the daytime beyond 22 miles, the night illumination would be appreciable through reflection from the clouds for at least 100 miles. A somewhat similar light at the entrance of Cherbourg Harbor, France, has been used as a guide by a vessel 100 miles off. This new light is of the revolving order, giving alternate flashes and eclipses, which further insures its recognition by navigators, and prevents its confusion with other sources of illumination. If no difficulties arise during the forthcoming tests, it is proposed to put the lens into practical operation at Barnegat without delay, and to ask Congress for several others, which might advantageously be located at Fire Island, Hatteras and other dangerous points.

Lincoln Park Electric Fountain.

Since the electric fountain in Lincoln Park, Chicago, was illustrated and described in the Western Electrician seven years ago, many changes have been made in it. The charm of novelty has worn

LINCOLN PARK ELECTRIC FOUNTAIN.

off, but the display is more beautiful and varied than ever, and still attracts throngs of spectators on every pleasant summer evening when it is shown. The season of 1897, now closed, was no exception, and the drawing power of the beautiful colors and graceful forms of the leaping waters seems unabated. The illustration shows the present appearance of the fountain in daylight, with central jet and surrounding "wheat-sheaves." This is but one of many possible combinations. The picture gives but slight indication of the brilliancy of the spectacle at night. Paul C. Just is in charge of the mechanism.

The question of installing a municipal light and power plant is to be submitted to the people of Toronto at the next municipal elections. The matter has been brought to this straight issue by the passage of the following resolution in the Common Council: "That it be an instruction to the city engineer to prepare an estimate of the cost of a plant of sufficient capacity to provide light for all municipal buildings, public streets and parks, and the supply of electric power to be offered to manufacturers as an inducement to locate in the city of Toronto, and that the question of installing an electric plant for the supply of electric energy for the above purposes be submitted to a vote of the duly qualified rate payers at the next municipal elections."

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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State of Illinois, County of Cook—ss:

Frank Foster Kenworthy being duly sworn deposes and says that he is a resident of the city of Chicago, in the county of Cook and state of Illinois, and that he is the superintendent of the binding department of the Electrician Publishing company, the publishers of the Western Electrician; that he was present at and superintended the binding of No. 24 of Vol. 20 of the Western Electrician, issued on June 12, 1897, and that there were sent out by actual count 20,000 complete copies of said Western Electrician of the volume and number above specified.

And further this affiant sayeth not.

FRANK FOSTER KENWORTHY.

Subscribed and sworn to before me this 27th day of July, 1897.

Chicago, July 27, 1897. IRA B. JONES, Notary Public.

Four Years' Record of Electric Light Convention Advertising.

Issue	Number of Advertising Pages.	Whole Number of Pages.	Square Inches of Paid Advertising Matter.
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From an eastern contemporary we learn that we have 'just reason to be proud" of our accomplishment in putting the Western Electrician, with a full report of the street railway convention, in the hands of our readers in Chicago early on the morning of Saturday, October 23d—within less than 24 hours of the adjournment of the convention. This is what the Electrical World says that it did, and it tells us all that the doing of the same was "some punkins" in the way of enterprise, if it does say it itself, as shouldn't. Niagara Falls is as far from Chicago as from New York, but it hadn't occurred to us that getting out the report at the proper time was an especially meritorious performance. But the Electrical World say that it was, and that by doing it in New York it beat the other eastern electrical papers by four days. Well, well! The World certainly has improved. At a certain important Niagara convention only a month before, its promptness wasn't so marked, if we remember rightly.

With the Armour Institute of Technology, the Lewis Institute, the Manual Training School and the Pullman Industrial School, Chicago will be very well equipped with practical institutions to supply technical instruction in the industrial arts. But it will be some time before the doors of the Pullman institution are thrown open to students. The will of the late George M. Pullman provides for the expenditure of $200,000 for lands and buildings and $1,000,000 for the maintenance, management and endowment of a free school of manual training for the benefit of the children of persons living or employed in the Chicago suburb which bears Mr. Pullman's name. His executors, Norman B. Ream and Robert T. Lincoln, and his friends, John M. Clark, John S. Runnells, Frank O. Lowden, Charles E. Perkins and John J. Mitchell, are requested to act as the first directors as soon as the corporation has been formed under the laws of Illinois. The gentlemen named are undoubtedly competent to execute the trust implied by the benevolent intentions of Mr. Pullman, who had long cherished the intention of founding an institution of the character named. The bequest is certainly very generous in amount, although it does seem unfortunate that only children of residents or workers in Pullman can participate in its benefits. However, there is an old adage reciting the impropriety of looking a gift-horse in the mouth, which seems to apply in this case. A splendid school will undoubtedly arise in Pullman, and the boys and girls, the young men and young women, of that suburb are to be congratulated. After a long delay, the opportunities for technical education—primary technical instruction, at any rate—seem to be springing up in all our large cities. We trust that all these institutions will so distinguish themselves by practical, useful work that the beneficent designs of their founders will result in the real and lasting good of their respective communities.

For a clear exposition of what has been accomplished in New England in the electrical transmission of power on steam railroads, one could ask nothing better than Col. Heft's paper, which is begun in this issue. Col. Heft attended the convention as a street railway man, he said, but as he is also one of the best known steam railroad managers in the country, his account of the experience of the New York, New Haven and Hartford Railroad company, with the lessons to be drawn from it, was gladly received. The management of the company is well satisfied with its electrical service, it seems, and, we gather, has under consideration the extension of it. Col. Heft is certainly not prejudiced in favor of electric traction, and his testimony is especially valuable and significant. "To the average railroad man," he says, "street railways have, until recently, seemed a pretty sort of toy, fit for apprentices in the art of transportation. Latterly, however, he has waked up to the fact that 'the tail will wag the dog' unless some radical action is taken, particularly in suburban and short-distance work, and, in the eastern sections of the country anyway, railroad men have become modest enough to be willing to look with respect upon the great work which has been accomplished in street railroading."

Attention is called by the writer to the superiority, in accelerating power especially, of the rotary motion of the electric motor, compared with the reciprocating action of steam locomotives. The third-rail is commended for use on surface roads; there has been no difficulty, as had been apprehended, from short-circuiting through accumulations of water during rainstorms. The question of danger from shock is, of course, an important one where the contact rail is on the surface of the ground. It is considered briefly by Col. Heft, who concludes: "We do not say that the third-rail has no dangers, but we do not consider the danger as being at all serious or one which should interfere with the extension of the system."

In his general summing up, the writer chooses his words with care. He evidently proposes, for his company, to test all things and hold fast to that which is good. Unlike those sensational journalists who seem to regard all things "electrical" as actuated by some all-powerful magic, Col. Heft has not consigned the steam locomotive to the scrap heap. But he does say, by fair inference if not in set terms, that heavy electric railroading has been tried and found excellently well adapted to certain traffic conditions heretofore served, but less efficiently, by the use of steam locomotives. Where these conditions prevail we may look forward with confidence to the ultimate adoption of electricity in every case.

A disclaimer filed on October 20th and promulgated in the Official Gazette of the United States Patent Office last week may prove of much importance to electric railway men. We quote from the text of the notice:

The Thomson-Houston Electric company enters this disclaimer to claims numbered 9, 10, 11, and 13 of said letters patent No. 495,443, without in any way hereby disclaiming any other of the said claims of said letters patent No. 495,443, or any of the subject-matters of said other claims, and without prejudice to any rights vested in your petitioner by or under any similar claims of letters patent No. 424,695.

Patent No. 495,443 is the one issued to the late Charles J. Vandepoele on April 11, 1893, and entitled "Traveling Contact for Electric Railways." It was assigned to the Thomson-Houston Electric company, and is the broad patent for the under-running trolley which, as the property of the General Electric company, has caused so much talk and litigation. As is well known, the patent covers the most practicable method of making electrical connection between an overhead trolley wire and a railway car—the method used by practically all the electric railway companies of the country. The question of the rightful use of the under-running trolley is of the utmost importance, and the possession of the patent has been of great value to the General Electric company. But on July 22d of this year the United States Circuit Court of Appeals in New York gave a decision in which this patent was held to be invalid on the ground that the invention had been patented by a previous patent issued to Mr. Vandepoele—No. 424,695, granted on April 1, 1890, for a "Suspended Switch and Traveling Contact for Electric Railways." Both patents originated in the application of Vandepoele filed on March 12, 1887. The application was divided, and, after interference proceedings in one case, the two patents were issued as before noted. The drawings are, for all practical purposes, identical in the two patents, but the claims of the later one are much broader than those of the first, and therefore it has been considered the valuable, fundamental patent. In setting aside the later patent last July, the court of last resort, through Judge Wallace, said: "It would be a waste of time to dwell upon the verbal differences in these claims. The changes in phraseology import nothing of substance into their respective combinations. They describe the same things in different language, and the draughtsman seems to have expended great ingenuity in cataloguing a group of synonyms." This decision was a great relief to street railway men, as the earlier patent, which still stands, of course, is comparatively narrow in its claims, and it is thought that it will cause comparatively little trouble. The decision is only binding in the states of New York, Connecticut and Vermont, but will undoubtedly be followed by other United States Circuit Courts of Appeal where the question arises.

The disclaimer now filed seems to be intended to have the effect of meeting the judges' objection to the later patent. It looks as though the General Electric company, holding fast to its earlier patent always, still hopes to accomplish something by the later patent in emasculated form.

Electric Pumps for Boilers.

A recent article in L'Electricien, by M. P. Simon, discusses at considerable length the question of water feed for steam boilers, dividing the necessities of the case under three heads. These are:

First—The water should be both chemically and mechanically as pure as possible.

Second—It should be fed into the boiler at as high a temperature as possible, being heated by waste steam only.

Third—The feeding apparatus should be simple, economical, and little liable to derangement or accident.

The third factor in the case appears to be open to more thorough discussion than the two former. In considering methods there seem to be but two which have place in the discussion—injectors and pumps.

The injector is open to serious objections. Its first cost is high; it can only be used economically with cold water; the quantity of water it is capable of handling is nearly or quite a fixed amount. If the water is heated for the injector it is expensive, because of the loss of steam used for this purpose. In addition to these objections, the injector sometimes gets out of order, and requires time (during which the boiler must be supplied by another means) to repair, as it is at best a rather delicate piece of apparatus, though not very complicated.

Pumps, on the contrary, are extremely varied, of all forms, sizes and action. They are readily changed to suit all circumstances.

The rated output may be doubled or tripled with ease; they will handle hot as well as cold water without difficulty. The system is capable of the greatest flexibility with the least inconvenience.

Where these are actuated directly by a pumping engine there is more work done at times than is required and the overflow runs back into the tank, making a loss of that much power. This sometimes amounts to two or three times the power utilized.

Putting these steam driven pumps on a multiple system of boilers, where several are fed from one source, the complication of pipes, valves, etc., becomes burdensome and objectionable. When the pump is actuated by a driving belt, in case of constant demand and continuous supply, the same objections obtain. In general, an independent power supply is preferable, as indicated by the great number of donkey engines in use for such service.

But these engines consume an amount of power entirely disproportioned to the good achieved. This is not to be wondered at. As a rule, the smaller the machine the less the efficiency. The author cites a pump which requires 400 kilogrammes of steam to produce one horse power of work.

There is an electrical method of disposing of the question. A motor, shunt wound, having a field rheostat, can be run at varying speeds and regulated with great precision by means of the adjusting coils. It will impart motion either through direct coupling or belting. One of these in service, operating a three-cylinder pump, is capable of most perfect regulation between very large limits. There are no shocks; the traction on the pulley is regular and constant. Such a pump has taken the place of a steam pump which consumed, according to circumstances, from 30 to 75 kilogrammes of steam per hour, while feeding the boiler with 600 kilogrammes of water. The horse power expense theoretically varies, then, between 130 and 340 kilogrammes of steam. Per contra, the electric motor which supplanted the engine absorbs six amperes at 110 volts, or 660 watts, which costs hardly 10 kilogrammes of steam. The economy is nearly 10 per cent. in coal consumed. Another instance is given where a similar application of electric power has effected a saving of 14 per cent. In addition to this there is a large economy in the item of oil by the electric system, which averages about 87 per cent.

A system of feeders for several boilers actuated by a single motor is suggested. A small reservoir is placed between the pump and the feed-pipe running to the several boilers, each of which is fitted with a check valve and an indicator. There is no waste of steam or power, and the whole operation of water feed is made perfectly automatic and thoroughly economical. With no demand on the reservoir the motor stops and the pump is still.

Sciagraphic Evidence in a Federal Court.

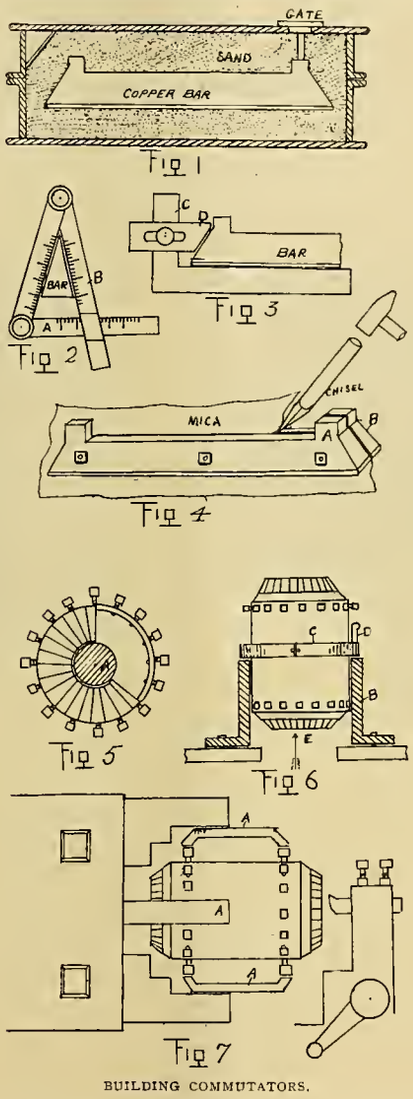
A sciagraph played an important part in a damage suit just tried in a United States court in Chicago. Charles Donnelly, a stockman of this city, some time ago sustained an impacted fracture of the thigh bone while accompanying a train-load of cattle which he was shipping eastward by way of the Fitchburg railroad. The train was wrecked and Donnelly's mishap occurred. Suit for damages was brought against the railroad company by the injured man, and the case was tried before Judge Allen. For the purpose of making clear to the jury the extent of the man's injuries, upon the advice of the plaintiff's expert, Prof. J. B. Hamilton, superintendent of the Elgin hospital for the insane, Donnelly's lawyers, Balkey, Gray & More, engaged W. C. Fuchs to make a sciagraph of the fractured femur. The judge admitted the picture, and it showed the injury so clearly that the jury did not hesitate to give the plaintiff a verdict for $12,500.

Building Commutators.

By B. F. Fells.

Fig. 1 is a drawing of a half of mold used by the writer for casting bars from pure copper. Fig. 2 is a new form of test gauge for determining the radius. It is made of tool steel, the sections hinged as shown, and the part A passed through a slot in the part B. If properly marked off, this gauge will aid materially in testing diameters, etc. Fig. 3 is another form of gauge, consisting of a square on one side, the extension (C) of which is provided with the beveled piece D. The adjustment of the latter is made with a thumbscrew. The use of the instrument is to ascertain the correctness of the beveled ends of the bars.

Having gotten the bars into shape, I next take up the mica, and instead of cutting it out to pattern by means of a cold chisel upon a flat surface, I now employ blanks A and B, as in Fig. 4, bolting the two blanks together with the sheet of mica



BUILDING COMMUTATORS.

between, as shown. I then secure the blanks in a vise and cut out the mica close to the pattern. This assures uniformity of the work, and does not take much extra time.

Coming now to the setting up, I first straighten any kinks in the bars, and remove all defects, such as lumpy places, knobs, etc., then shellac the bars and stand them up to dry. I then treat the mica with shellac, seeing to it that no scales are left open, and making the sheet as solid as is possible. Some years ago I did not give much attention to any kind of a cement substance, and depended wholly upon a tight adjustment of the bevel to keep things together. But I found that it was frequently necessary to repack and turn the commutators in order to keep them in shape. Since adopting the shellacking method, following it up with proper baking and hardening, I have had much less trouble with loosening of parts.

Fig. 5 shows the process of building up the segments. I first build the lower half circle, then put in a mandrel A and complete the rest. If the final bars fit too tight, I force the bars already in with wedges, holding them in position with the setscrews until the last bars are placed.

The baking process can be accomplished by placing the commutator over a coke fire, oil lamp, gas burner or brazing jet. Ordinarily, the cylinder is permitted to stand motionless while the heat cooks the shellac until hard and dry. Lately I have tried the plan shown in Fig. 6 with success, consisting in setting the cylinder up with a band (C) about it, and this band is arranged to bear upon an outer cylinder rim B. The latter is shown in section. A handle is provided at D with which connection can be made with something to protect the hand from the heat, and the cylinder is slowly revolved during the baking. This results in uniformity of the drying-out process and increases the rigidity of the combination. The heat is introduced at E, passing out at the top.

Next we have the commutator at the lathe for turning, flanging, truing, etc. The custom is to chuck by the set screws, but as the set screw heads are likely to slip at times, I have recently used secondary pieces A, as shown in Fig. 7, which pieces are made of steel and of right proportions to reach across two set screws, as shown. The chucking is then made upon these cross-pieces in such way as to distribute the pressure over screws on either side of the cylinder. Truing the center, filing and other work may be done at this time, and while the work is in the chuck I use muriatic acid and zinc for a flux.

I get efficient results with amber mica for insulation. All commutators should be carefully tested and inspected before leaving the shop, as some minor defect which could be easily rectified might ultimately cause considerable trouble if the same were not remedied at the shop.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the Western Electrician.]

The Dakota Central Telephone company of Aberdeen, S. D., has completed work on an extension to Sisseton, S. D., and Brown's Valley, Minn. The company will extend to Beardsley, Wheaton and Graceville, Minn., if given sufficient support.

The Harrison Telephone company has about completed its exchange at Rapid City, S. D.

A local telephone exchange is projected at Mankato, Minn., and stock subscriptions are being taken quite rapidly. The committee will continue its work until 300 instruments and stock for $10,000 are signed for. The Western Electric, Union Electric, Blue Earth Valley and New Ulm Telephone companies are all anxious to connect their toll lines with a Mankato local exchange. The Northwestern Telephone Exchange company has added another operator to its Mankato exchange, owing to increased business.

The time-honored privilege of swearing at the central operator because a line is busy has produced trouble at Fargo, N. D. Landlord Cole, of the Hotel Metropole, is alleged to have sworn at the telephone girl, and the instrument was taken out of his place of business by Manager Garrett of the Northwestern Telephone Exchange company. It was afterward replaced. Later Cole went to the office and is said to have struck Garrett twice with a cane.

A canvass is being made at Hastings, Minn., for a local telephone exchange.

Manager Willits of the Wisconsin Telephone company's Ashland exchange has been promoted to take charge of the exchange at Milwaukee.

The Northwestern Telephone Exchange company has connected with Fairmont, Minn. This company will soon have its line between Willmar, Minn., and Granite Falls, Minn., in operation. A right of way has been secured for a line from Canton, S. D., to Sioux City, Ia. The poles are up between Sioux City and Hudson, and work is being pushed to complete the line.

A. L. Waterbury of Mason City, Ia., has been interviewing business men in Graceville, Minn., with a view to establishing telephone connection with that place.

The recent announcement of rates by the new Houghton County Telephone company of Houghton, Mich., is followed by the announcement of the Michigan Telephone company of a reduction. The local manager also said his company would cut any rates made by the new company.

The Iowa Telephone company is just completing work for the season on a toll-system covering the entire state. There are 3,500 miles of copper metallic return circuit, reaching the cities along the Mississippi River, north to the Twin Cities, southeast to Ottumwa and other towns and west to Council Bluffs. Next year the system will be completed to reach every county seat in the state, and give each connection with the other.

The Wisconsin Telephone company is giving free telephone service at Centralia, Wis., to compete with the local exchange there.

The Northwestern Telephone company has a crew of men at work pushing the construction of the line between Canton, S. D., and Akron, Ia. At the latter place it connects with the Iowa Telephone company.

The Wisconsin Telephone company is preparing to perfect its systems in Eau Claire and Chippewa Falls, Wis., putting in additional wires between those cities and also putting in a metallic circuit between Chippewa Falls and Menomonie.

The Minnesota Central Telephone company will

establish a telephone exchange at Annandale, Minn.

Rowe Bros. of Pierre, S. D., propose a telephone system to connect with the small towns between Pierre and the Black Hills. The line is to reach Midland this fall and the Hills next year.

The Southwestern Telephone company of Dodgeville, Wis., will extend a line from Linden to Rewey.

A franchise for a new local telephone exchange will be applied for at Marshfield, Wis.

The Elgin Telephone company of Elgin, Minn., has begun construction work on a line to Potsdam, and will later build to Rochester, Minn.

The Wisconsin Valley Telephone company announces it will push work on a telephone exchange in Eau Claire, Wis., and one at Chippewa Falls at once, and will have both exchanges in operation by January 1st.

The Northwestern Telephone Exchange company will soon connect with Renville, Minn.

Polyphase Plant for Factory Transmission.

Nelson Morris & Co. of Chicago, the large meat packers and shippers, are erecting an extensive establishment in St. Joseph, Mo. It will be equipped for electric lighting and power transmission throughout, and the contract for the electrical machinery has been secured by the Westinghouse Electric and Manufacturing company, through the efforts of Frederick Nelson of the Chicago office. It is interesting to note that, although direct current was considered for this plant, polyphase machinery will be used, although at a greater first cost. There will be two generators—one of 250 kilowatts at 440 volts and a smaller machine of the same type of 120 kilowatts capacity. These are to be driven from a line shaft by belting, and two engines supply the power, the arrangement of clutches being such that either dynamo can be driven by either engine. The engines are of the Corliss slow-speed type, and are to be furnished by the Vilter Manufacturing company of Milwaukee. The installation will include 23 motors, ranging in size from three to 40 horse power. These motors will drive pumps, hashers, conveyors, hoists and oleo presses. The illumination will be furnished by about 800 incandescent lamps and 30 series arcs. The latter will be supplied with current by a separate dynamo. The Westinghouse contract includes the switchboard instruments.

Heat-unit Standard Advocated.

At the Hartford meeting of the American Society of Mechanical Engineers, William S. Aldrich, of Morgantown, W. Va., a member of the society, read a long paper on the rating of electric power plants upon the heat-unit standard. It is Mr. Aldrich's opinion that the progress of power plant engineering has reached such a stage of development that electric power plants should be contracted for on a somewhat similar basis of guaranteed performance as that now in vogue for pumping plants. There should be guaranteed a definite output in the case of the electric plant to be measured at the switchboard and expressed in kilowatts per 1,000,000 British thermal units supplied to the steam used in the whole plant. Mr. Aldrich suggested the following advantages of having such a standard for this purpose, founded on the heat-unit basis: It is a simple basis, involving quantities easily measured. It applies to all plants operated by any kind of a heat engine. It forms the most satisfactory basis for comparison of plants. It will facilitate the predetermination of the performance of electric power plants. It will promote the most economical arrangement of plants. Heat-unit specifications will form a proper basis of agreements. Contract trials of electric plants should be based on heat-units. It will advance this industry along engineering lines.

W. Elliott of Chicago has purchased the electric light plant at Antigo, Wis., and has contracted to furnish the city 25 new arc street lights for $84 each per year.

Barrier and Quick-break Switches.

Of the switches used by the General Electric company upon the alternating current switchboards manufactured at its works in Schenectady, one is the double-break switch, commonly called "T-H." This has recently been improved by placing barriers between the blades, making it satisfactory for use on circuits with a potential up to 2,300 volts. The other is the so-called "safety" switch, which has the contacts on the back of the panel, while the blades are on the front. When this switch is closed the blades pass through holes in the marble and enter contacts. Barriers are also placed between the blades of this switch. The blades are insulated from the metal back which holds them. Thus, when closed, no current-carrying part of the switch is exposed, and the chance of shock becomes almost impossible. For higher voltages and inductive loads, especially designed switches are constructed to meet the requirements of the case.

The quick-break switches for use on circuits of nominal 500 volts manufactured by this company are constructed with the view of obtaining the greatest accuracy. The switch-blade contact consists of two pieces laid edge to edge, and connected to a common hinge. The contacts are also connected by a pair of spiral springs, one on each side. Both sections of the blade make connection with the contact clip. In opening the switch, the outer section of the blade, to which the insulated handle is attached, is withdrawn to an angle of 30° before the inner section moves. The inner half of the blade then begins to move, forced from the clip by positive action; as it leaves the clip it is drawn smartly up to the outer half of the blade by the action of the tension springs. The result is a quick break and a wide gap, over which an arc cannot hold. Switches of this type, made in capacities from 50 to 5,000 amperes at 750 volts, are constructed for the single and double throw, with or without bases, with either front or back connection, except with the 1,800, 3,600 and 5,000 ampere switches, which are not furnished with bases unless on special order. Single-pole switches, three-point, four-point, etc., are also manufactured by the General Electric company, and are of great convenience in many cases. They swivel at the hinge connection and may control any reasonable number of circuits. Like the standard switches, they are built with bases or back connections for switchboards as desired. The base of the 50 ampere switch is of porcelain; slate is used for the larger sizes.

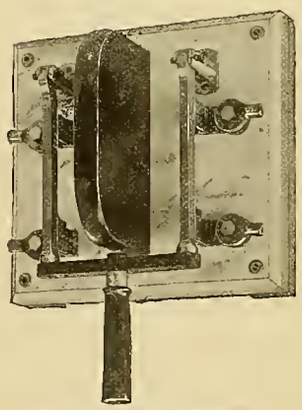


Fig. 1. Switch with Barrier.

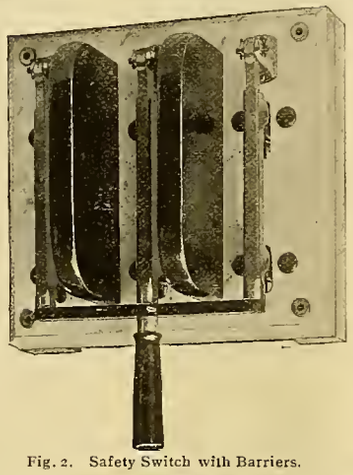


Fig. 2. Safety Switch with Barriers.

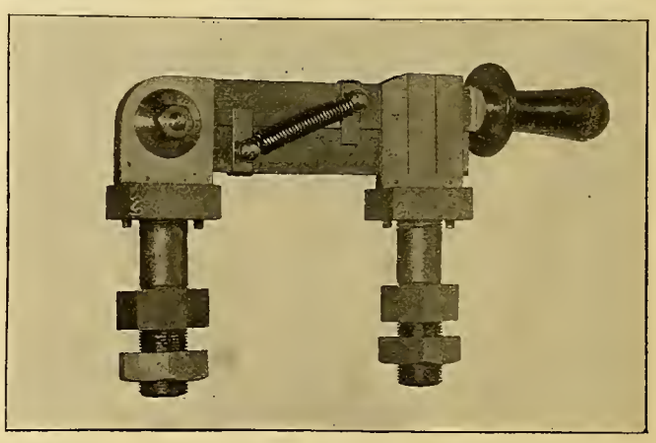


Fig. 3. Quick-break Switch without Base.

BARRIER AND QUICK-BREAK SWITCHES.

Application of the Storage Battery to Electric Traction.

By Charles Hewitt.

Part II.

Cost of Operating.—From volt and amperemeter readings taken from the power house in October, 1896, we find that 136,576,919 watt-hours was delivered to the line at the battery house. These figures, I may explain, do not include the watt-hours generated by the booster, since we have assumed that this entire amount is lost in transmission. As a matter of fact, this is not strictly correct; but if a station were operated at Chestnut Hill, it would be run at a bus-bar pressure a little above the battery pressure, and therefore for our present purposes the assumption is correct. From our experience in operating power houses of various capacities we find that a power house operated at Chestnut Hill under conditions which I have described would cost about 1½ cents per kilowatt-hour. We therefore get the following as the cost of generating the number of kilowatt-hours required by the Chestnut Hill branch during the month of October, 1896, if furnished by a station at Chestnut Hill:

134,848 kilowatt-hours at 1½ cents	$2,022.73
Interest on $85,000 at five per cent. per annum	354.17
Depreciation on machinery, etc., at five per cent. per annum	354.17
Insurance, taxes, etc.	200.00
Total cost of operation for the month by direct method	$2,931.07

Actual Cost of Operating the Battery and Booster.

Watt-hours delivered to cable No. 3 by bus-bar	136,576,919
Watt-hours generated by booster	34,234,648
Total watt-hours delivered to cable No. 3	170,811,567

The cost of operating the power house for the month of October, exclusive of interest and depreciation, was seven mills per kilowatt-hour; therefore, we obtain the following:

170,811,567 kilowatt-hours at 0.7 cent	$1,195.68
Cost of labor and supplies at battery house	179.73
Total	$1,375.41
Depreciation of battery at five per cent. per annum	83.33
Interest at five per cent. per annum on $33,000	137.50
Taxes, insurance, etc.	32.00
Total cost of operation	$1,628.24

Deducting this from the cost of operating by a station at Chestnut Hill, we find the difference in favor of the battery for the month would be $1,302.83.

Since October 1, 1896, the method of operating has been somewhat changed, and by installing watt-meters more accurate data has been obtained.

During the month of May, 1897,

	Watt-hours.
There was delivered to cable No. 3 at 550 volts	101,750,000
" " " " by booster	28,960,380
Total " " " at station	130,710,380
Total delivered at battery house	103,673,448
Less amount lost in battery	620,000
Total output at battery house to line	103,053,448

103,053,448 watt-hours at 1½ cents per kilowatt.	$1,545.80
Interest on $85,000 at five per cent. per annum	354.17
Depreciation at five per cent. per annum	354.17
Insurance, taxes and miscellaneous	200.00
Total cost for May, 1897, by direct method	$2,454.14
Actual cost of operating battery:	
130,710,380 watt-hours at 0.6 cent per kilowatt.	$ 784.26
Cost of labor and supplies	163.67
	$ 947.93
Depreciation of battery at five per cent. per annum	83.33
Interest at five per cent. per annum on $33,000.	137.50
Taxes, insurance and miscellaneous	32.00
Total cost of operation	$1,100.76

Note:—Cost of operating power house for May, 1897, was 0.6 mill per kilowatt-hour. Five per cent. depreciation of battery is amount guaranteed by makers.

Deducting $1,100.76, the actual cost of operating battery for May, 1897, from $2,454.14, the cost if station had been built at Chestnut Hill, we find a saving of $1,353.38 in favor of the battery.

We may safely say, therefore, that the saving by using the battery is about $1,350 per month, or about $16,200 per year.

Recapitulation.

Saving in cost of installing battery over a new power station for Chestnut Hill	$52,000.00
Saving in operation per annum	16,200.00

These results speak for themselves, and need no further comment. The following data may also be of interest:

	October, 1897.	May, 1897.
	Watt-hours.	Watt-hours.
Highest charge for 24 hours	456,000	303,000
Lowest charge for 24 hours	312,000	150,000
Average charge for 24 hours	385,161	218,380
Highest discharge for 24 hours	456,000	250,000
Lowest discharge for 24 hours	216,000	150,000
Average discharge for 24 hours	329,419	198,380
	Per cent.	Per cent.
Average efficiency for the month	85.5	90.8
Average day charge in amperes	46	45.8
Average night charge in amperes	155	. ..
Average discharge in amperes	50	43.7

Ratio of the night charge to the day charge: Highest, 4 to 1; lowest, 1½ to 1; average, 2.63 to 1.

Ratio of day charge to discharge:	Oct., '96.	May, '97.
Highest	1 to 4.45	1 to 1.5
Lowest	1 to 1.86	1 to .78
Average	1 to 2.95	1 to 1.10

Specific Gravity.

Maximum specific gravity at 6 a. m. 1.211
Minimum specific gravity at 6 a. m. 1.2
Average specific gravity at 6 a. m. 1.207

The above are the specific gravities at the end of full charge.

Maximum specific gravity at 6 p. m.....1.201
Minimum specific gravity at 6 p. m.....1.184
Average specific gravity at 6 p. m.....1.192
Maximum specific gravity at 12 p. m.....1.194
Minimum specific gravity at 12 p. m.....1.182
Average specific gravity at 12 p. m.....1.188

At a specific gravity of 1.16 the battery would be about empty; so that we find at no time was the battery more than half discharged.

At the end of 15 months of continuous operation, we have only had to repair two leaky tanks, at an expense of about $25. The positive plates look as good as when first installed, and show no depreciation whatever; the negatives, on the other hand, have contracted somewhat and some of the plugs have cracked, but this in no way impairs their usefulness.

This method of power distribution cannot be considered economical per se, but where the conditions are such as we have described, there is no question as to the economy in favor of the battery.

Application of Battery to Power House.

This form of installation has not become very generally appreciated in this country, and but few installations have been made. As its advantages become better known, I feel confident the practice will become more general.

The wide fluctuations in load in railway power houses is now well known. The average daily load varies from 50 per cent. of the maximum in small stations to 70 per cent. of maximum in the largest stations. From a very large number of observations in all parts of the country, I find that in the majority of stations the average load is very close to two-thirds of the maximum load. Now it is also a well-known fact that the maximum economy of the steam engine exists for a very small range of load, and that on each side of the point of maximum economy the efficiency falls off; rapidly on the overload, somewhat less rapidly on the underload. The result is apparent. In most stations the engines, at the best, have an average load of only two-thirds their most efficient load, and as a consequence consume over 4.5 pounds of coal per kilowatt-hour.

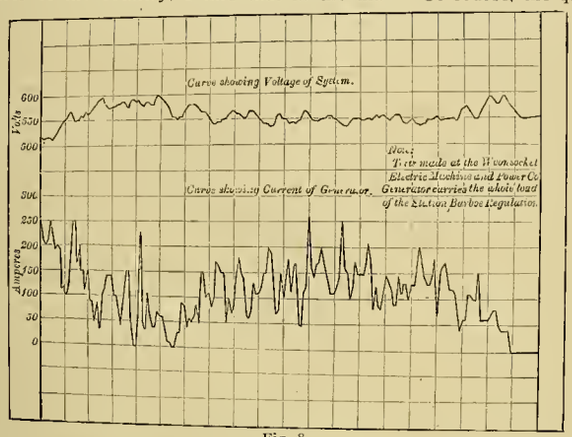


Fig. 8.

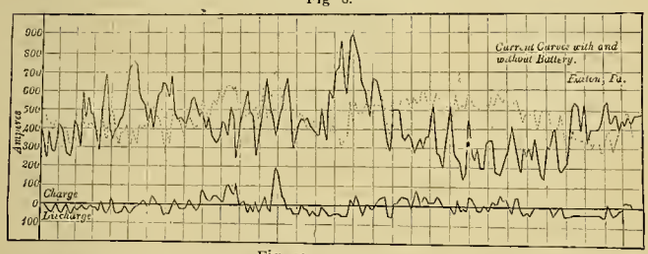


Fig. 10.

With badly regulated engines, and especially with water power plants, the changes in load are accompanied by variations in speed, and consequently in voltage. These troubles may be entirely corrected by installing a battery.

The battery in this case becomes distinctly a load regulator. Figs. 8 and 9 show results obtained at Woonsocket, which is a water power plant. In Fig. 8 the load is carried entirely by the generators and, as is to be expected, the potential curve is very irregular, varying almost 100 volts, while the current varies from zero to 250 amperes. The action of the battery is shown in Fig. 9, where the generator load varies about 50 amperes and the potential curve is most regular. Fig. 10 shows the results obtained at Easton, Pa. In this case the battery is quite small, and the advantage is not quite so marked as it would be if a larger battery were used. Instead of using four generators, however, they are able now to operate the same number of cars with three engines. No cost figures of these plants are made public, but the increased efficiency is made apparent.

It is necessary that the capacity of the battery should bear a larger ratio to the output of the station than is necessary for potential regulation as described in the previous section of this paper. In potential regulation a comparatively small battery is necessary, since by changing the potential of the booster from time to time during the day the charge and discharge can be kept very low. In the case described a battery rated at 120 amperes has successfully regulated for a total output of 1,400 amperes. For load regulation, however, the battery should have a capacity equal to one-third the maximum output of the station. The average load of the station may then be made the maximum load of the engines, the battery taking care of the fluctuations.

As in the previous case, there are no physical limitations to be placed on the size of the plates to be used, and the charge and discharge may be kept well within the normal rates. Under such conditions the efficiency of the battery is high, 85 per cent. to 90 per cent., and the deterioration very low. In most cases no additional labor will be required.

Discussion.

I. A. McCormack, Brooklyn: Mr. Hewitt, I understood, stated that there were two cities in the United States where a car storage battery would be applicable. I would ask what cities he referred to.

Mr. Hewitt, Philadelphia: I have in mind the cities of New York and Washington. There may be other cities which would like to have that system, but these are the only two which are seriously considering it.

John MacFayden, Chester, Pa.: Do you recommend the storage battery in conjunction with the booster in smaller stations, or the booster itself, say with a capacity of 900 amperes?

Mr. Hewitt: From my observation I believe that all small stations would be benefited in a large measure in their economy, if they had a storage battery. Of course, the question of investment must be considered in all these cases; but, as a general principle, the operation of the station would be economized, if the battery can be used as an auxiliary.

Mr. MacFayden: What is the difference in cost between the kilowatt output of the booster, independent of the battery?

Mr. Hewitt: The only case in which I have had personal experience is the one in Philadelphia. I assume the output of the booster to be the same as the general output of the station. We do not keep separate records of the cost of it, and it would be impossible to do so. The steam furnished for the battery engines is from the same source as the steam furnished for the other engines, and we could not separate them; but I have taken the cost of the station for the months described, and assumed that was the pro rata cost of the kilowatt-hour generated by the booster.

W. E. Harrington, Camden, N. J.: I ask Mr. Hewitt if the manufacturers of the battery installation have guaranteed the depreciation, and if so, what the guarantee is?

Mr. Hewitt: The storage battery people will guarantee the depreciation, and they have guaranteed the depreciation in our case. I believe it is for five or 10 years, and at a certain rate pro rata to the cost of the battery. I do not feel at liberty to say just what the figure is. I do not think, however, that there is any special secret about it. Any man who wants to purchase the battery will get the information from the battery company.

W. S. Patterson, Salt Lake City: I am very much interested in Mr. Hewitt's paper. It brings out some things that I have been thinking of on this line. We in Salt Lake City have a steam plant as well as a water power plant, and we are now running our system by water power 18 miles from the city. We have occasionally, not often, been caused to shut down, once from a snow slide, which swept away the channel which we had around the mountain, and once from losing a bucket off the wheel. We still have our steam plant kept in good running order, but it takes from an hour to an hour and a half to steam up when these things occur. I was thinking when listening to the paper, that it might be possible that we could operate a storage battery in connection with our plants. I would like to ask Mr. Hewitt if, in his opinion, we can profitably use a storage battery, and if it would be a plausible scheme to turn the current after shutting down (we are at present, on average days, not counting the big days, running from 300 to 500 amperes), and run the plant by a battery; and if so, at which end of the plant would it be best to put the battery? I presume, of course, at the transformer end.

Mr. Hewitt: I think I am right in saying that the transmission referred to by the gentleman is an alternating current transmission; and there are difficulties in working a storage battery in conjunction with the alternating current. For that reason it would be impracticable to put the battery at the generating end. To put it at the steam plant end, which, I presume, is in the city, is simply a question of dollars and cents. A battery can be bought large enough to run any road in the United States, if you want to pay for it. It takes a pretty large battery to run the road, independent of all other sources, but it is simply a question of dollars and cents entirely. In using the battery, in conjunction with other sources of power, as I have explained in the paper, you take up simply the fluctuations, and let the station do the main work; but to have a battery installation large enough to do the entire work, and make up the fluctuations as well, you would find it necessary to have a pretty large battery for any ordinary road, but it can be done, if you want to buy it.

Mr. McFayden: Would you consider it economical to have a booster and storage battery combined, as a booster line, where you would only want the power at certain times, during heavy loads on heavy grades? The reason I ask is, that we have a booster and only use it as required, and we have very good results, using it without any storage battery at all. I do not know about the economy. Would it be better to have the battery in conjunction with the booster, for such work, or turn the generator into a booster? We can use it either way, as required. If we do not use it as a booster, we can run it as a generator.

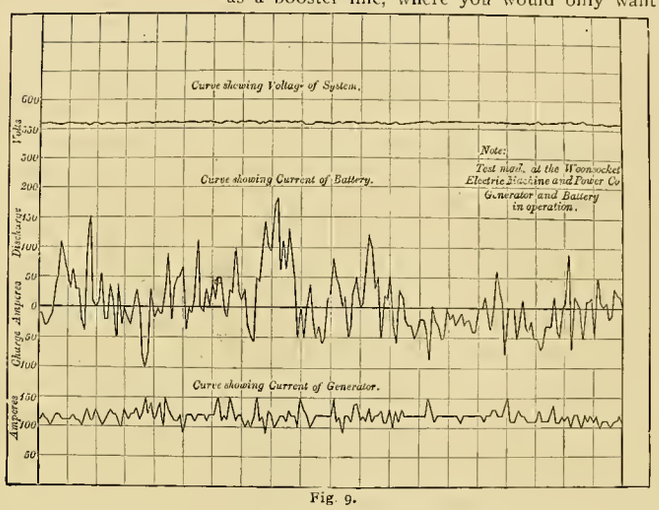


Fig. 9.

APPLICATION OF THE STORAGE BATTERY TO ELECTRIC TRACTION.

Mr. Hewitt: In the case referred to at Chester, I do not think the battery would add to the economy. The battery, as a potential regulator on the end of a long line, becomes useful when the variations are so great that in case of a sudden stopping of the cars the potential would go so high as to do damage. For instance, at Chestnut Hill, on our plant there, we at times have the booster as high as 250 volts above the usual 550 volts, making 800 volts in all. If the cars should be stopped or blocked at any point, the potential would go very high, and become dangerous and blow out the lights in the lamps and cause damage to controllers, and other evil consequences would be sure to follow. The battery prevents the pressure going up in such cases. In the case the gentleman has spoken of, where the potential does not have to be boosted so high as to be dangerous, and is only boosted at times of heavy load, when the potential on the end of the line is within safe limits, I do not think it would be economical to use a battery. The local conditions of every case must be considered in all such installations.

Mr. Mundy, Lowell: I desire to ask about the application of the battery, particularly in suburban work, such, for instance, as race-track travel, without the use of the booster. If the battery were mounted in cars, would it be practicable to run these cars out in cases of special loads to the end of the route, where you will have the load, and then, during the race, or anything of that sort, charging the battery from your line, and at the instant of starting the cars, pulling off at the same time the battery, and discharging back into the line, to carry you over the heavy peak? What do you think of such an application? You could use that same battery, in times of long waits of that kind, by having a side-

track at the station, and run it in to act as an auxiliary at the station.

Mr. Hewitt: That is one of the variations of the scheme used abroad which is perfectly possible. It is a matter, of course, on which an opinion could hardly be given in an off-hand way such as this. It would have to be considered entirely with a view to the local conditions. The cost of the battery would have to be considered against the cost of putting up the necessary line work, and running cars under these conditions, and the cost of maintaining the batteries would have to be considered as against the cost of running the cars in the other way. It might in some cases prove valuable, and it might in other cases prove very costly. I could not give an off-hand opinion or estimate at the present time.

Mr. Mundy: Which do you consider would be the more economical? The use of the battery or the use of the booster?

Mr. Hewitt: I am hardly prepared to give a judgment in an off-hand way in a case like that.

H. H. Littell, Buffalo: This is the most important question, as far as dollars and cents are concerned, that has been brought before this meeting—the question of saving money. The gentleman talks of a saving of $33,000. It has been shown to us that we can save $75,000 yearly in our operation by the use of the storage battery, and I am almost led to believe that we can do it, but we have not made any contracts yet. I believe we ought to hear from all of the storage battery men. They have not asked me to make this request, and I have not talked with them on the subject. I believe we should give thm an opportunity to say what they have to say. I ask that unanimous consent be given to the various representatives of the storage batteries to state the merits of their respective batteries.

President McCulloch put the question asking unanimous consent to have the representatives of the storage battery companies address the meeting; but as objection was raised by some of the members that the time of the convention would not permit this, the opposition prevailed.

Mr. Mundy: I ask the question if it is practicable to construct these batteries so that you could handle them on cars without drawing the liquid from the cells?

H. H. Littell: That shows the necessity of hearing from the battery men. The battery Mr. Hewitt described does not go on the cars, and is not supposed to be put on the cars.

Mr. Mundy: I mean with reference to what I said a few minutes since, using it at the end of the line. Could it be handled in a car of that kind, to stand jolting, without spilling the cells?

C. P. Wilson, Sioux City, Ia.: During the last few years a number of the smaller plants throughout the country, those which are operating a load from 300 to 1,000 amperes, have installed direct-connected units, a great many of them using compound engines. As Mr. Hewitt stated, those engines run at their highest efficiency only through a small range of the lead. Now, in these smaller plants these engines run at very light load the most of the time. Mr. Hewitt spoke, briefly I thought, of the application of storage batteries to stations for load regulation. I would ask him if he can say anything further on that point, and give some idea of what saving could be effected in stations of the size I have mentioned.

Mr. Hewitt: I spoke briefly on that subject because there has been so little done in that line. If I had gone any further, it would have been in the line of argument only, and I wanted to keep as close to the facts as possible. In the case at Easton, it required four engines to run their cars. At the present time they run with three engines. That of itself shows that these three engines will run more economically than four in the previous case, the number of cars remaining the same. The difference will be between the economy of an engine running at approximately its maximum economy and an engine running at a low economy. Just what the difference is at Easton, I do not know, because I was unable to get the exact data; but it would probably be a difference of 25 per cent. in the coal. If an engine is running at a low economy, with five or six pounds of coal, at a low average load, and you increase the load to its maximum economy, you can probably reduce the coal per horse power hour output down to 20 or 25 per cent.; but, in addition to that, you must deduct the loss in the battery itself, so that the net saving would possibly be 20 per cent. or thereabouts. I do not wish to quote that as an authority, because I have not the facts.

Mr. Harrington: I would inquire if there is any person present who has had experience in the question which has been raised, as to the matter of percentage of efficiency between running with or without the storage battery. It has been raised in our particular case, and just that one question is the hinging point, I think, more than anything else, to decide the question with us—just what saving would be effected, what the percentage would be. Mr. Hewitt thinks it would be about 20 per cent. If any of the Easton people are here, they would probably know.

W. C. Ely, Niagara Falls: I agree with Mr. Littell that this is probably the most important question coming before us, as it means, if successful, the saving of thousands of dollars. We are taking power for the Buffalo and Niagara Falls railway, and the other street railways of Buffalo as well, from these large generating companies, the Niagara Falls Power company and the Niagara Falls Hydraulic Power and Manufacturing company. They generate the power and sell it to the street railway companies at so much per electrical horse power per annum. You will see at a glance that the street railway company has to pay for that power, whether it is used or not, and for eight hours of the day, on an average, but a small quantity of the power will be used, and for a certain number of hours, on our line particularly, for four or five hours, no power whatever is being used; but we are paying all the time the fixed ratio for the entire amount of power. If the accumulator could be used to store the current, and we could use it at times when we might not take it from the power companies direct, it would be a saving to our companies of thousands of dollars per annum. In Mr. Littell's case it would be a great saving. His company is taking 1,000 horse power daily per annum from this transmission line, and they are going to take more. Mr. Hewitt, in your judgment, as the result of your investigation, has the state of the art advanced to that degree that storage batteries or accumulators may now be safely, practicably and economically installed to meet such cases?

Mr. Hewitt: Yes, sir; I think the batteries can undoubtedly be installed in such cases, with economy. It is merely a question of size. If you install a battery powerful enough to do the work it will do it well and reliably. The trouble in most cases has been an overrating of the batteries. The batteries are expensive, and in most cases the railroad companies have been afraid to buy a battery large enough to do the work well. If you buy a battery which is too small, it will go to pieces. If you pay enough money to get one that will last you for years, it will do the work well, and will be a valuable auxiliary. Whether it will be a saving to any considerable extent in this particular case, I could not say off-hand. It could be figured out and possibly effect a considerable saving. From what you have said, I can see that if you are paying for a 24 hour day, and you could accumulate a certain amount of power in an accumulator, you might reduce the amount of power which you are paying for; in other words, if you are paying for a thousand horse power hours you might reduce it at the end of your present contract to a lower amount, and use your power then the whole 24 hours. That is a possibility; whether it would save you money, I would not wish to say off-hand. It would have to be considered; the expense of the battery, maintenance and such things would have to be figured out. As far as the physical possibilities go, it is perfectly feasible.

D. B. Dyer of Augusta, Ga., offered a resolution of thanks to Mr. Hewitt for his able paper. Mr. Dyer's motion was carried, President McCulloch thanking Mr. Hewitt for his answers to members' questions.

Application of Electricity to Railroads Now Operated by Steam Power.[1]

By H. N. Heft.

Part I.

The New York, New Haven and Hartford Railroad company owns and controls about 2,800 miles of main line railroad track in New York, Massachusetts, Rhode Island and Connecticut, of which about 16 miles are operated by electricity on the third-rail system and 14 miles on the overhead trolley system. The company also owns the entire capital stock of the Stamford Street Railroad company and the Meriden Electric Railroad company, the former operating about 10½ miles of track and the latter about 17½ miles on the overhead electric system. It is through my official connection with the Meriden company that I am permitted to be present at the meeting of the American Street Railway association—a privilege which I thoroughly appreciate.

Electric railroading on a large scale is but the development of street railway experience, and if the future brings success in the efforts now being made to use electricity for heavy work, it will be due, largely, to the courage and enterprise of those who have "blazed the path of progress" and forced the fighting by entering into competition with an industry which believed itself, 10 years ago, absolutely secure in its position.

There is little for me to tell you of novelty in the work done by the New Haven company in Meriden and Stamford. These are ordinary street railway systems, fairly well equipped, and we try to operate them to serve the public properly. Believing, as we do, that a good track is the foundation of a good system, we have thoroughly reconstructed the track in both cities with heavy rails. In doing so, we have paid the most careful attention to the matter of return circuit, bonding the rails so thoroughly as to make them the path of smallest resistance back to the station. We have thus avoided, to a very large extent, trouble with electrolysis. Nothing is more certain to my mind than that carelessness about making a track return circuit is a most serious mistake, and that carelessness about testing and maintaining joint connections is another. I would rather spend a thousand dollars or more in providing ample carrying capacity of rail bonds than to put the same amount of money into the overhead circuit, if, by doing the latter, I should neglect the former.

About three years ago, the New Haven company found that various electric railways in its territory were gradually extending their operations into the field of interurban work, and that the company's passenger earnings were suffering accordingly. It was at once seen that by no ordinary methods of changing schedules or increasing speeds could this lost traffic be won back again, and, with characteristic knowledge and courage, President Clark and the New Haven directors determined to "steal the thunder" of its new competitors, and commenced a series of elaborate experiments in heavy electric railroading. It must be confessed that this decision was reached only after some misgivings. To the average railroad man, street railways have, until recently, seemed a pretty sort of toy, fit for apprentices in the art of transportation. Latterly, however, he has waked up to the fact "the tail will wag the dog" unless some radical action is taken, particularly in suburban and short-distance work, and, in the eastern sections of the country anyway, railroad men have become modest enough to be willing to look with respect upon the great work which has been accomplished in street railroading.

The first line to be equipped by the New Haven company was a purely summer road, operated for about four months in the year only, through a narrow peninsula running out from the mainland on the Massachusetts coast from Nantasket Junction to Pemberton, a distance of about seven miles of double track. This line was chosen partly because the main-line operation would not be interfered with in case of trouble with the electric trains, and partly because of the existing heavy summer traffic which would put the new apparatus and the feasibility of the entire system to a severe test. An overhead trolley line was built, with center pole construction, and everything made very strong and more substantial than was at that time found in any street railway work to our knowledge. At the time of construction of this overhead line, there were no suitable movable switches in the market, and we had to remodel and have built especially for our purpose those which we finally adopted. One feature perhaps worthy of note is the connection of the overhead switch with the track switch in such a way that both are controlled by a single lever at the switch stand.

The line was operated for the first summer with excellent success, and, all fear of trouble having disappeared, an extension of 3.6 miles was made on the main line of the company's Plymouth division, from Nantasket Junction to East Weymouth, this section being operated by the third-rail system.

In December, 1896, we commenced work on a new line running from Berlin, Conn., through New Britain to Hartford, a distance of 12.3 miles, three of which, from Berlin to New Britain, is a double track, and the remainder, from New Britain to Hartford, a single track. A power station was built at Berlin, one end of this line, partly because of a desire to test transmission of power to a considerable distance, and partly because Berlin is the center of several radiating lines which may eventually be put into operation by electricity.

The physical characteristics of both these lines have been so carefully and accurately described in technical papers that I shall only refer to them more or less incidentally in the following, confining my remarks chiefly to the results which we have found, and the conclusions which we have reached in our own minds as to the best methods of applying electricity in heavy railroad work.

Train Service and Traffic.

We have learned very thoroughly, in our street railway experience, the lesson of the importance to any transportation agency, working in a thickly populated territory, of uniform fares and a frequent and regular train service—of a train service which requires no printed schedule to enable people to know when cars may be found in waiting. The time has come when every progressive railroad manager must recognize that new conditions and the new character of competition require a complete change of operating methods.

On its Nantasket Beach line, the New Haven company gave, during the last summer, a regular half-hour service from 6:30 in the morning until 11:30 at night. When unusually heavy boatloads arrived at Pemberton from Boston, trains were run in as many sections as were found necessary to take care of the people, but still the half-hour schedule was not departed from on ordinary days. On Sundays and holidays, when boats arrived at Pemberton every 15 minutes during the greater part of the day, express trains between Pemberton and Nantasket were sandwiched in between accommodation trains in such a way as to give a 15-minute schedule of alternate express and accommodation trains. The time-table this summer required 33 regular trains daily, each way, between East Weymouth and Pemberton. During July and August the traffic increased to such an extent as to require six motor cars in constant week-day service, and on Sundays and holidays 11 motor cars have frequently been called for.

The fares charged on the Nantasket Beach line before the advent of electricity were 10 cents from Pemberton to Nantasket and 18 cents from Nantasket to East Weymouth, a total of 28 cents from Pemberton to East Weymouth. With electric traction they have been placed at a uniform rate of five

1. Read before the American Street Railway association at Niagara Falls, October 21, 1897.

cents from Pemberton to Nantasket and five cents from Nantasket to East Weymouth, a total of 10 cents from Pemberton to East Weymouth. Under these new conditions, the traffic has increased enormously on this line; the summer of 1895, the first of electrical operation, showing an increase of 92.6 per cent. over the previous summer in the number of passengers carried; the summer of 1896 showing 45.1 per cent. increase over 1895; while in the summer just passed we have carried nearly three times as many passengers as in the last year of steam operation.

The operation of the line from New Britain to Hartford was commenced in May last, with a regular half-hour train schedule from six in the morning to 11:30 at night, and with a uniform fare of 10 cents each way, instead of 23 cents, the former charge. The electric line carries through passengers only between Hartford and New Britain, the passengers for the five way stations being carried by the regular steam trains running on a parallel track. For ordinary every-day service, a single open motor car was used during the past summer, while for extra loads, light double-truck trail cars, seating 70 people, were attached. On rainy days a standard closed passenger coach was hauled by the open motor car. On holidays and Sundays the cars pulled two trailers, the entire train seating nearly 250 passengers. About the middle of August steam service on the Berlin-New Britain branch was discontinued, and traffic has since been handled entirely by electricity. Sixteen trains each way per day are run, connecting with steam trains.

Under the conditions named on the Hartford-New Britain line we have carried, during the three summer months, 400 per cent. more passengers than we carried through the corresponding months of last year.

Speed, Acceleration and Schedules.

I do not suppose that any but a trained railroad man can understand the impossibility of operating trains and maintaining schedules by steam locomotives in the way that has been done by electricity at Nantasket Beach this summer. There are a great many curves on the line, and several grades. There are no excessively sharp curvatures or steep grades, and it is not here that the trouble has come. The difficulty is found in the fact that there are no less than 17 stations on a line only 10.6 miles in length, or an average distance between stations of but about six-tenths of a mile. To make a run of 10 miles with 16 stops in 26 minutes; to be obliged to do this in order to connect with boats arriving at regular half-hour intervals, and to keep out of the way of frequent regular steam trains on the main line of the Plymouth division; to allow but four minutes at each end for unloading, switching (including running around trail car), and loading; and to do this day in and day out, in regular service, through an entire summer—these are things which cannot possibly be accomplished by steam locomotives.

Now the reason why electricity can do this and steam cannot is found in the tremendous accelerating power of properly designed electric motors, with rotary motion, as compared with reciprocal motion of steam locomotives. A 60 ton train, in running from Windermere to Allerton, a distance of only 1,800 feet, reaches a maximum speed of 31 miles per hour, while in the longer run from Power Station to Nantasket Junction, a distance still of but 5,808 feet, a maximum speed of 39 miles is reached. The entire distance is covered, in regular service, at an average speed of 24.6 miles per hour, including stops.

Between Hartford and New Britain the 9.3 miles distance is covered regularly by motor cars with the two trailers in from 18 to 20 minutes, an average speed of from 28 to 30 miles per hour, while, with a special high-geared motor a maximum speed of over 60 miles has been made, the entire distance of 9.3 miles being covered in 10 minutes. On this line a 52-ton train often reaches a maximum speed of 50 miles per hour. The current is cut off at 29 grade crossings when single-car trains are run.

It is worthy of note in this connection that the line between New Britain and Hartford is in direct competition with a trolley line between the same points but following a more circuitous route. The schedule time of trolley cars is 55 minutes, as against our time of less than 20 minutes, and the rate of fare is 15 cents (including a transfer given for use on the steam railways of either city), as against ours of 10 cents for the straight run between the two cities only. The ownership of right-of-way has a very important influence upon speed and competitive conditions under circumstances like these.

Cars and Equipment.

The type of car selected for any good transportation service has a direct bearing upon the development of traffic and maximum gross receipts. It has been difficult for steam railroads to depart far from the long established custom of closed passenger coaches of the present standard type, and to adopt open cars, on account of the disagreeable effect on passengers of the smoke and gases from engines. This has naturally thrown a great deal of traffic to competing street railway lines running open cars in summer, on account of the much greater pleasure in riding.

With electric operation, open cars in heavy railroad practice are possible, even at considerable speed, particularly if the front of the car is closed in with glass, and both at Nantasket Beach and on the Hartford-Berlin line we have used heavy open cars with great success.

The motor car which we have so far used we do not consider, by any means, the final type, and even now we have in mind plans of combination cars which we believe will be, on the whole, well adapted for railroad work. The present motor car is very heavily built, with floors of a height equal to that of our standard passenger coaches. It contains 16 cross seats, capable of seating 96 passengers, and the entrance is from either side, with three steps. Each car has two heavy railroad trucks, one of which is equipped with two 125 horse power motors. The total weight of the motor car is 32 tons, and the trailer car of the same type weighs 25 tons. The motors which we have used up to date have been of a type common in heavy elevated railway work. These motors have often been in service for several consecutive days, making 324 miles each day, without apparent injury. We found the motors we are using already in the market when we commenced our experiments, and until recently no attempt has been made by us to specify changes. Under these circumstances great credit is due the manufacturers for their efforts to meet the difficulties encountered. The experience gained with these motors has served as a basis for building larger and heavier types, better adapted for the severe work which they will be called upon to fulfill to meet our requirements. An important point which we shall specify in new motors is that they shall have the most perfect ventilation possible. The efforts of manufacturers have been hitherto directed toward completely encasing the motors, so as to make them waterproof, but in doing this ventilation has been sacrificed.

We have found it beneficial to blow out our motors several times during the day by means of a blast of air from a hose-pipe connected to our air-brake reservoir, but this is, at best, but a makeshift.

It is very difficult to dispose of all the necessary cables, wires, brake rods and chains, air-brake cylinders and apparatus, switches and other car-controlling mechanism in the limited space beneath the car floor, as may be readily imagined by those familiar with street railway work. As a consequence, there has always been more or less controversy between those responsible for the placing of the different portions of the equipment, as to who shall have the first right to a given space, perhaps hardly half a dozen square inches in section. There is also more or less trouble with abraded wires, short-circuited shoe hangers, etc, and for our future work we are making an effort to simplify this mass of equipment mechanism by putting some of it, particularly the wires and cables, in a space between the true floor of the car and a false floor several inches below, specially provided for the purpose.

For operating heavy trains of this character, where currents of from 500 to 1,000 amperes are sometimes used, the controlling apparatus must be massive and strong in every part, and the greatest care must be taken to prevent arcing. We have had no trouble with controlling apparatus on our regular equipments, and we consider this branch of the apparatus well perfected.

The danger to station and car apparatus from lightning discharges, which is so important a factor in street railroading where the overhead system is employed, is avoided in third-rail work, since the third rail is so close to the ground that it is practically a lightning arrester itself throughout its whole length.

The problem of braking, which is so important a one in street railroading, is found more so with us, since the train weights and speed are enormously greater. The regular Westinghouse air-brake system, with engineer's valve, is used on our electric trains, but instead of steam air compressors we have an electric motor compressor, controlled by an automatic regulator, which has given excellent satisfaction.

Our experience with trolleys on the overhead line at Nantasket Beach, originally put in two years ago, has not been satisfactory. We find it quite impossible to prevent the destruction of trolley wheels by almost continued arcing when attempting to take from the wire the heavy current required in starting and during accceleration, as well as the smaller currents taken at the maximum speed. There has been a good deal of trouble, moreover, in keeping the trolleys on the wire in making speed and taking curves, and many trolley poles have been broken. The trolley difficulties have not interfered with the continuous operation of our line, but the cost of replacing wheels and poles has been rather large.

These difficulties have had an important influence in causing us to reach a decision in favor of the third rail. The contact shoes which take the current from the rail to the motor circuit have given, on the whole, good satisfaction, although they are occasionally carried away by the approach blocks at grade crossings, when these blocks happen to be slightly misplaced so that the shoe strikes them at the wrong angle. The contact shoes are suspended by cast-iron links, which are intended to be weak enough to allow the shoe to break away easily without doing damage to the framework of the car. The trail cars are also equipped with shoes and connected with the circuits on the motor car by means of flexible couplings, and it is possible, therefore, when the cars are run in train, to bridge the longest gaps found at grade crossings and switches, so that it is not necessary to turn the current off on approaching these. This arrangement makes our trail cars independent of the motor car for heating and lighting.

The Nantasket cars have two trolley poles as well as contact shoes, and the changing from trolley to third rail simply means the pulling down of the pole and the closing of the third-rail switch.

CORRESPONDENCE.

New York Notes.

New York, November 1.—The daily and technical press is devoting much attention to Mr. Edison's plan for extracting the metallic oxide from iron ore of suitable character by using the principle of magnetic attraction. The idea is not a new one, and the inventor has been working on it for years, but it is only now that the plant is considered to have reached a stage of development suitable for publicity. A great establishment has been built at Edison, N. J., and it is said that the company working the mines has 16,000 acres of land under its control. In outline, the plan is to crush the ore and to subject it to the action of a series of electro-magnets of varying strength. By this means the particles containing any considerable proportion of metallic iron are separated from the residue, which is called "sand." The separate ore or "concentrate," about one-fourth of the crude ore treated, is molded into briquettes and shipped to the blast furnaces to be reduced to pig-iron. The economy of the plan is twofold—in increasing the output of the blast furnaces from 35 to 50 per cent. and in reducing very greatly the freight charges for hauling the ore from mine to furnace, as one ton of "concentrate" yields as much iron as four tons of crude ore. Against this, of course, is the cost of working the concentrating works at the mine's mouth, but where the work is done on a large scale and by the use of a number of labor-saving devices invented by Mr. Edison, it is said that the whole operation shows a satisfactory profit. Of course the geographical location of mines and furnaces cuts a great figure in the calculation, and then, too, some additional revenue is expected from the sale of the "sand" as a by-product. The details of the construction and operation of the great magnets have not been given out. This is perhaps natural enough at the present juncture. One writer gives this account: "From the stockhouse the ore goes to the magnet tower, on the inner side of which are ranged a series of magnets 12 inches wide and six feet long. The upper ones are the weakest, the middle somewhat stronger and the lowest the most powerfully energized by the current influencing them. The ore is dropped in from the top of the tower. As it falls the metallic particles are deflected by the magnets and turned to one side, while the 'tailings,' in the form of sand, fall to the bottom of the tower, where they are removed to the sandhouse. To every ton of ore there are three tons of sand. The sand receives special treatment, according to the purpose for which it is intended—building, cement or lime work, foundries, locomotive and electric car sand-boxes, sand blasting, etc. That for which no present use can be found is thrown out on the sand heap, which bids fair soon to need a small county to itself. The 'concentrates' are subjected to a second and then a third series of magnets, which give them the finishing separation. They are passed into a stockhouse, and are ready for mixing with the binding material, which gives cohesion and other necessary qualities to the briquette. Mr. Edison made several thousand experiments before he discovered a suitable medium for this purpose." As has been stated, the economy of operation lies largely in the automatic devices planned by the great inventor. Conveyors, for instance, are seen in various forms all over the Edison works. They are an important part of the general scheme of economy of labor, which is carried out rigidly. In fact, it is said that from the moment the rock is mined to its shipment as a finished product not a hand touches it, every part of the process being automatic.

The body of Miles H. Landon of this city was found on Friday near the ferry slip at St. George, Staten Island. The last seen of the unfortunate gentleman was on October 21st, when he left his office to go on a business errand to Staten Island, and preparations to endeavor to locate his whereabouts had been begun when the news was received of the finding of his remains. Mr. Landon was well known in electrical circles. He was formerly cashier for the Weston Electrical Instrument company in its office at New York. He was a cousin of M. D. Landon, "Eli Perkins." He was one of the prominent members of Kismet Shrine of Brooklyn, in which a number of electrical people are members. His death will be a great shock to his friends in the East, as well as in Chicago and vicinity, where he was well known. M. S.

Northwestern Notations.

Minneapolis, November 2.—The St. Paul Assembly has followed in the footsteps of the Board of Aldermen, by adopting, at its last meeting, a resolution calling for a thorough investigation into the status of the street electric railway company. The

council and the rapid transit company are having much difficulty in getting at an understanding.

The fire commissioners of St. Paul awarded the contract for a new fire-alarm system to the Gamewell Fire Alarm and Telegraph company. The new equipment, which is known as the manual system, will cost $9,040.25. A central office with 30 circuits is called for in the specifications. The contract was awarded after Assistant Electrical Inspector Varnum and Superintendent Carey had inspected the United States company's system at Columbus, Ohio, and the Gamewell system in operation at Detroit, Mich.

A party of engineers has been making a preliminary survey for an electric line connecting Minneapolis with Lake Minnetonka. The scheme is a feasible one, and prominent citizens are behind it. An electric line already runs to St. Louis Park, and the new line would probably extend from there to the popular summer resort. It is understood that work on this improvement will be pushed in the spring.

A new scheme is about to be inaugurated on the popular interurban electric line which will commend itself highly to business men and university students who live in St. Paul. It is proposed to run fast "special" cars, which will make the distance between the two cities in 30 minutes, instead of 50, as at present. An experiment was made by changing the form of the motors slightly and adding a new brake on car No. 615, and it was found that a mile in one minute and 31 seconds could be made, including five stops. To run the "specials" various sidetracks will have to be built for the regular cars, and only five stops will be made in the outlying portions of both towns. The right-of-way for the additional tracks has been secured in Minneapolis and will be in St. Paul when the trouble with the council in that city is settled.

The Minneapolis council has decided the lighting question. The bid of the General Electric company of this city was accepted. It provides for 650 lights on a moonlight schedule at $100 per year, and 150 on all-night schedule at $118 per year Two thousand gasoline lights and an indefinite amount of gas lamps will also be used to illuminate the city. The committee reported that the city of Minneapolis gets its light considerably cheaper than other cities.

Morgan Brooks, president and general manager of the Electric Engineering company, has gone to New York and Boston to spend a month attending to business matters.

The Gladstone Electric Lighting and Power company has petitioned the District Court for a dissolution of the corporation. It is represented that all claims have been paid in full. Judge Johnson has set December 11th as the last day in which claims, if such there be, may be filed against the company.

Burger Bros. have been granted a franchise for electric lighting at Pine City, Minn. They will do business as the Pine City Electric Light and Water company. The equipment has been ordered and will include machinery for 600 incandescent and 100 arc lights.

People of Lakeside, a suburb of Duluth, Minn., have a vigorous complaint to make on the street-car service they get. It is infrequent and inadequate, and they propose to have the council compel a better service. The council started to do so once before, but on promises of the street railway company refrained. This time promises "don't go."

A collision occurred on the Citizens' Traction company's line in Oshkosh, Wis., in which the vestibules of both cars were smashed, and two passengers slightly injured. One car was waiting for the other to stop on a switch to pass, but the second car was running at such a rate of speed that it went through the switch and into the waiting car.

Daniel Haynes of Troy, O., will engage in the electrical business in Bedford, Ia., with C. Wiley.

The council of Neenah, Wis., has come to terms with the Fox River Valley Railway company, and a franchise has been agreed upon. The mayor of Menasha served an injunction on this company to prevent it from using wooden poles in that place, and called a special meeting of the council to compel the use of iron poles. The council, however, voted to permit the use of wooden poles.

S. L. Doying and E. J. Letford contemplate establishing an electric light plant in Osakis, Minn. They will canvass the town, and if enough support can be pledged, will put it in.

City Electrician Joslyn of Tacoma, Wash., has been dropped, in the interest of economy, and in his place comes E. Bachelet as foreman of lines, being promoted from lineman. As the office is under civil service rules it will be abolished, and the new office formed.

Steps are being taken at Cloquet, Minn., to secure electric street lighting from the Northern Lumber company's new plant.

W. I. Gray of Minneapolis predicts that most of the towns of North Dakota will be lighted by electricity soon.

W. H. Clement has retired from the Polar Star Electric company of Faribault, Minn., and is succeeded by H. O. Clement.

W. D. Evans has resigned as engineer and custodian of the city electric light plant at Le Sueur, Minn.

The street-car controversy in Oshkosh, Wis., has come to an end at last by the Citizens' Traction company absorbing the horse-car line, and the latter has ceased operating. The purchase price was $37,000. The electric company is pushing work on a line on Ninth street.

A plan for the consolidation of the electric railway companies at Green Bay, Wis., and the electric companies is being considered.

The Board of Public Lands and Buildings of Nebraska contemplates putting in an electric lighting system to furnish light for the five state buildings at Lincoln—the state capitol, asylum, university, penitentiary and Home for the Friendless.

The City Council of Grand Forks, N. D., has instructed the city engineer to prepare plans and specifications for a municipal electric lighting plant. The estimated cost is $13,324.

Arthur E. Appleyard, secretary and treasurer of the Chippewa Valley Electric Railway company, announces that the line for the interurban to Chippewa Falls from Eau Claire, Wis., is a sure go. It is proposed to plow and scrape and set the poles before frost strikes into the ground, and if this can be done, to continue construction through the winter. In any event, the line is expected to be in operation by May 1st.

L. G. Van Ness of Lodi, Wis., has applied for a franchise for electric lighting in Dodgeville, Wis.

Even Aspnes of Granite Falls, Minn., contemplates establishing an electric light plant at Madison, Minn.

Electric light business in Sauk Center, Minn., is booming, and many orders for lighting private residences are coming in. Additional dynamos will be put into the plant.

The Windom, Minn., electric light plant is furnishing light to the limit of its capacity. The system is more than self-sustaining, but a new engine, boiler and dynamo are needed to meet the demands. The receipts are said to be $400 per month and the expenses $180.

Mr. Hodges of Kent, Wash., contemplates putting an electric light plant in at Ritzville, Wash.

C. G. Keebler has sold his interest in the Fairmont, Minn., electric light plant to B. E. St. John, his partner, and the latter now controls the plant.

A resolution has been introduced in the council at Sioux City, Ia., looking to municipal ownership of the street railway systems.

It is announced that Philadelphia capitalists have bought $260,000 bonds of the proposed electric line to run between Oshkosh and Berlin, Wis., and the funds will be used in the constructing and equipping of 22 miles between those cities. Construction is to be begun as soon as the funds are paid over.

The electric light plant in Moorhead, Minn., is not meeting with a smooth path in its progress. The council has made war on certain saloonkeepers who were getting lower rates, and one has put in a private plant. Another is securing gas from Fargo, N. D., instead of using electric light.

C.

PERSONAL.

T. J. Mosher of the Furniture City Electric company, Grand Rapids, Mich., visited Chicago last week.

D. Brunner Heilman, superintendent and electrician of the Standard Electric company of Reading, Pa., was a recent Chicago visitor.

Geo. F. Porter of New York, who is manager for W. R. Brixey, manufacturer of Day's Kerite, as well as secretary of the National Electric Light association, was in Chicago during the week.

Announcement is made that Nelson W. Perry, for several years editor of Electricity of New York, has retired from that journal to accept a position with Westinghouse, Church, Kerr & Co. and the Westinghouse Machine company. Although by education and experience an engineer of approved capacity, Mr. Perry is likewise so well adapted for technical journalism that his retirement will occasion sincere regret. He re-enters the field of active engineering work, however, with the best wishes of the friends he has made by his journalistic labors. His new business address will be 604 Havemeyer building, New York.

On the afternoon of October 29th a jolly party of prominent gentlemen passed through Pittsburg en route to Omaha, as the guests of Capt. John Sheridan, government director of the Union Pacific railroad, vice-president of the Mt. Savage Fire Brick company and president of the New York Mining company. Capt. Sheridan had been tendered the private car Delaware, starting over the Baltimore and Ohio railroad from Baltimore, Md., and had invited as his guests to Omaha Col. J. A. Robinson, a prominent capitalist of West Virginia; Supt. A. E. Hutchins of the Barton and George's Creek Valley Coal company, Frostburg, Md.; J. B. Oder, editor and publisher of the Mining Journal, Frostburg, Md., and General Agent V. L. P. Shriver of the Mt. Savage Fire Brick company's Pittsburg office. Capt. Sheridan, who is a prince of entertainers, as well as one of Maryland's keenest and most prominent citizens, being due in Omaha on Union Pacific business the morning of November 1st, took the opportunity of entertaining the gentlemen named by having them with him on his trip. The car Delaware was to have remained at Omaha a few days, and thence Capt. Sheridan was to take his party home, possibly by a route through St. Louis.

ELECTRIC LIGHTING.

The Treasury Department is inviting sealed proposals until November 30th for installing an electric light and power plant for the postoffice building at Washington, D. C. Proposals will be received as follows: First, for tubing and wiring the building; second, for dynamos and engines; third, for the plant complete. Prospective bidders can obtain full specifications upon application to the chief clerk, Treasury Department, Washington, D. C.

United States Consul Childs has informed the State Department that an electric light plant has been established in Ch'ang Sha, capital of the most exclusive and hostile province in China, where, a few years since, the people refused to allow telegraph poles to be erected. A native company has been organized to light the city with electricity, and it will only be a short time before it will be under way, as most of the capital has been subscribed. The consul states that the public buildings will be electrically lighted and that prejudice is giving way to the modern invention.

At the special term of the Supreme Court held in Buffalo on Monday, November 1st, Justice Titus appointed John F. Moffet of Watertown as temporary receiver of the Medina, N. Y., gas and electric company's plant. The appointment was made at the request of Attorney Edward Jellinek. The Holland Trust company has begun an action to foreclose a mortgage given by the Medina corporation to secure an issue of bonds in the sum of $75,000. It was this company that Attorney Jellinek represented. He stated that under the mortgage the application could be made without notice, consequently the application for the appointment was not opposed. He also said that the company had had a contract to light the village of Medina, but that the contract had been abrogated by the village. In addition to this the village trustees had ordered the gas company to remove all its wires, poles, conduits, etc., from the streets, but that the company did not want to do this. There was no income from the plant and no funds in the treasury, therefore he desired the appointment of a receiver to restrain the village from acting; also to pay the taxes on the property, as it was going to ruin, and a sale of the plant for taxes had been threatened. The receiver is the largest bondholder.

TELEPHONE.

The Missouri Telephone Manufacturing company took this week what is said to be the largest telephone order ever placed in St. Louis. It was for 500 telephones, to be placed in the new independent telephone exchange now in course of construction at Ottumwa, Ia.

MISCELLANEOUS.

The next annual meeting of the American Electro-therapeutic association will be held in Buffalo on September 13th, 14th and 15th of next year. Dr. Charles R. Dickson of Toronto, Ont., is the president of the association, and Dr. John Gerin of Auburn, N. Y., is the secretary.

In a little more than half a year the value of the exports of electrical apparatus from the United States has amounted to more than $2,000,000, which represents an increase of about $500,000 over the figures for the corresponding period of last year. This increase, while noteworthy, is likely to be small in comparison with the increase which will be seen before another year has elapsed, as the foreign demand for American electrical supplies is apparently growing stronger.

Work has been commenced at Niagara Falls on the new factory of the National Electrolytic company, which is to be located on the property of the Niagara Falls Hydraulic Power and Manufacturing company. John Sandstrum has the contract. The main building will be of brick, 40 by 85 feet, and 2½ stories high. The company will make chlorate of potash.

Assistant Secretary Howell has instructed customs officials that in the opinion of the Treasury Department the duty of 90 cents a hundred on electric light carbons should be based upon the length of the carbons as used in the lights. In order to avoid paying this rate of duty importers had the carbons shipped to them in pieces of sufficient length to make three for commercial use, and insisted that the long pieces should be admitted at the rate fixed by the tariff law. The question was presented to the department a few weeks ago by Appraiser Wakeman of New York.

TRADE NEWS.

The Swarts Metal Refining company, Chicago, has been kept exceptionally busy during the last two months. As is well known, this concern is always on the lookout for scrap copper, for which it is willing to pay a good price. Street railway and electric lighting companies, therefore, will find

it to their advantage to communicate with the Swarts company whenever they have on hand old copper which they wish to sell for cash.

The Pittsburg Reduction company has reduced its price for aluminum sheets, so that, considering the weight factor, it is claimed that aluminum is a cheaper metal than brass.

The Automatic Switch company of 703 Equitable building, Baltimore, makes a fine line of motor-starting switches, elevator controllers and reversing switches. It sends a descriptive booklet on application.

Recent inquiries from Japan and Mexico for K. McLennan & Co.'s commutator compound, in which the Western Electrician is mentioned, show the far-reaching effect of advertising a standard article in a well circulated medium.

Roth Bros. & Co., 30 Market street, Chicago, the well-known manufactures of electrical machinery, report a brisk trade. This firm has installed a number of its new multipolar and bipolar machines, which have given the best of satisfaction.

The Simplex Electrical company, through H. R. Hixson, the western selling agent, has recently secured several good contracts in Chicago, including the insulated cables for the electrical equipment of the South Side elevated railroad, underground lead-covered cables for the city of Chicago and the South Park commissioners.

The Hartley Electrical Works, 263 Randolph street, Chicago, dealers in second-hand electrical machinery, have in stock a number of excellent bargains. It may pay those looking for good second-hand electrical machinery to correspond with the Hartley company. The company also does a large business in electrical repairing.

Manager Otto Reiman of the Reliable Electrical Supply company, Chicago, reports that during the first month of his new business matters have progressed most satisfactorily. The Reliable company has recently started its salesmen on the road for a second trip, and it is the intention of Manager Reiman to soon add another man to travel a different section of the country. The Reliable company has recently footed up its business and, with great satisfaction, found it beyond expectations.

A new plan of paying for instruction in electrical engineering and the other subjects which they teach by mail is announced by the International Correspondence Schools, Scranton, Pa. Students may enroll upon paying a small sum in advance, the balance being payable in monthly installments. The schools were established in 1891. They have been very successful in teaching by mail, their students exceeding 25,000. Full information regarding the schools and their electrical courses is given in a pamphlet of 112 pages which will be sent free.

Prof. William D. Marks of the American Electric Meter company of Philadelphia has brought his meter to a high degree of perfection. During a recent call of a representative of the Western Electrician many commendatory letters from those who have been making practical tests of the instrument during the past year were noted. Among many points of merit claimed for this meter are that it requires no knowledge of electricity to erect; it shows the load passing out every instant; it is hermetically sealed, and is calibrated ready for immediate use; it will measure correctly with uneven loads; it can also be calibrated with a watch in six minutes; guarantees are given that it requires no lubrication; it is mechanically shielded, and it is direct reading, having no multiplier. Probably the strongest point claimed for it is that it does not require one-thousandth of a horse power to operate it, and it can be used for several years without opening.

General Agent V. L. P. Shriver of the Mt. Savage (Md.) Fire Brick company's Pittsburg office passed through Chicago last week in the private car Delaware on the Baltimore and Ohio railway, en route to Omaha as the guest of Capt. J. Sheridan, government director of the Union Pacific railroad. Capt. Sheridan is also vice-president of the Mt. Savage Fire Brick company. The Mt. Savage Fire Brick company is one of the oldest concerns of its kind in the country and has many friends in and around Pittsburg and Chicago as well. Under the management of Mr. Shriver its Pittsburg business has increased rapidly. Mr. Shriver's office is at 609 Park building, Pittsburg, where he also represents the Fidelity company of Baltimore as general agent.

BUSINESS.

Johnson & Morton of Utica, N. Y., issue a blotter with blank spaces for memoranda. The firm does electrical repairing.

The successors to the Metropolitan Electric company of Chicago have on hand a large line of porcelain white tubes, as well as clay tubes in all sizes, which they are furnishing to the trade at "bargain prices."

Everyone desires to keep informed on Yukon, the Klondyke and Alaskan gold fields. Send 10 cents for large compendium of vast information and big color map to Hamilton Publishing company, Indianapolis, Ind.

Recent publications describing automatic circuit breakers for direct current circuits for potentials not exceeding 750 volts and switches for circuits not carrying over 600 volts may be had of the Westinghouse Electric and Manufacturing company of Pittsburg.

The city of Chicago has given the Boiler Expurgator company, Chicago, an order for a quantity of Holm's "Tesoline" commutator compound to be used in city plants. The company is placing large quantities of this compound in some of the largest plants in the country.

The Electric Appliance company reports that it is rapidly reaping the benefits of the complete distribution of its new issue of General Catalogue No. 12, and that it is resulting in a large increase in the business and the opening of many new and desirable accounts. The Electric Appliance company is certainly entitled to reap its reward, as the catalogue issued is a very elaborate one and has been published and distributed only at great expense.

Geo. W. Patterson, general western agent for the Medbery electric street railway material, and also for the Gordon-Burnham Battery company, reports the prospects of business as being excellent. Mr. Patterson has recently gotten out a unique card that should be of decided interest to every business man. It is entitled "Periods When to Make Money." From the way Mr. Patterson is now hustling it would seem that he fully appreciates the fact that now is the accepted time.

Considering all the difficulties in the way of making a satisfactory light for the wheel, the Ohio Electric Works are certainly to be congratulated on their recent success in their four and three-cell outfits. It is claimed that these lights cannot be jolted out; that they throw a light 200 feet, and that they will run four hours on a charge costing two cents. One customer says: "Your three-cell light is fine on a dark night; it throws a light 200 feet. Everyone who has seen it says it is the coming light. I cannot say too much in praise of it." This is the way users of the Ohio electric bicycle lights are talking. For a new catalogue, for 1898, now ready, address Ohio Electric Works, Cleveland.

The Stromberg-Carlson Telephone Manufacturing company is reporting not only a general increasing trade for complete exchange and toll-line apparatus and private plant equipment, but is having a large demand for its "triplet" from old exchanges for re-equipping. This apparatus is especially adapted for re-equipping instruments, as it comprises all parts of a telephone excepting the magneto and blackboard, and it can be readily attached to any make of telephone, and it completely changes the talking circuit.

The only train in the world on which the traveler may perform the functions of social or business life with as much ease as within the walls of a private house is the Pennsylvania Limited, with its barber shop and bath, stenographer and typewriter, commercial and news reports fresh from the wires; cosy boudoirs; palatable meals; enclosed bed rooms, single and en suite; and the only observation car running to New York. Apply to H. R. Dering, assistant general passenger agent, 248 South Clark street, Chicago, for particulars.

The Charles H. Besly company, Chicago, dealer in general specialties for use in electric light and street railway plants, etc., reports a marked improvement in its business. The company has received a number of orders from abroad for its products. It is needless to say the specialties of this company have a wide reputation. The Besly company is at present having a large demand for its brush copper for electrical purposes, which seems to meet with favor. The company announces that the August edition of its catalogue is just out and will be mailed to anyone free of charge on request.

The Scott & Janney Electric and Maufacturing company of 1707 and 1709 Filbert street, Philadelphia, feels proud of the awarding of the contract to it for 10 motors to operate the ammunition hoists to be used on the United States battleship Alabama now in course of construction by Wm. Cramp & Sons of Philadelphia. This was an order which attracted the attention of nearly all the manufacturers of electric motors, and it is understood that it was upon very close investigation into the merits of the various apparatus that the order was given as above stated. These motors will be of the company's standard iron-clad type for direct current.

The business formerly conducted by D. A. Kusel and Jas. S. Cuming, under the firm name of the D. A. Kusel Telephone Manufacturing company, will in future operate as the Central Telephone and Electric company, D. A. Kusel having sold his interest and good will in the business to R. T. Durrett, who will have charge of the financial department of the new company, while Mr. Cuming will give his entire attention to the practical management of the business. All instruments heretofore manufactured by the D. A. Kusel Telephone Manufacturing company will be manufactured by the Central company, though it will make such improvements as experience has taught will elevate the standard of excellence to the highest point obtainable. All the books, accounts and correspondence of the old company are the property of the new company. Therefore any reference to former correspondence will receive intelligent attention. The company will soon issue a new catalogue and price list, which, it is claimed, will be the most complete of its character ever printed. In the meantime the company will be glad to furnish revised prices on any article in the telephone line.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued October 26, 1897.

592,244. Electrical Power Transmission. Thomas J. Fay, Brooklyn, N. Y. Application filed February 12, 1897.

The driven machine is placed within a hermetically sealed casing. An electric motor has a rotary member consisting merely of a body of iron located inside of the casing and connecting with the machine to be driven, and a stationary member upon which the electrical conductors of the motor are wound located outside of the casing. An unperforated wall of the casing is located between the rotary and stationary members.

592,245. Electric Hair Drier. Heinrich Fütterer, Dusseldorf, Germany. Application filed April 13, 1897.

Insulated wire, electrically heated, is used on a sliding comb-plate held by a frame.

592,249. Face Plate for Flush Switches. Gerald W. Hart, Hartford, Conn. Application filed November 5, 1896.

The patent covers the details of making a face-plate with a recessed portion to receive the push-button.

592,259. Electrical Equipment for Vehicles. Sidney H. Short, Cleveland, Ohio. Application filed August 27, 1896.

The combination with a movable vehicle, of translating devices carried thereby, a carbon in electrical connection with one of the terminals of the translating device, a metallic oxidizable material in electrical connection with the other terminal of the translating device, an aqueous electrolyte maintained in an unheated condition in which the carbon and metallic material are immersed or partially immersed, a pump carried by the vehicle and arranged to deliver oxygen to the electrolyte through the metallic material, and means actuated by the movement of the vehicle for operating the pump.

592,269. Electric Vibrating Bell. Henry F. Albright, Elizabeth, N. J. Application filed July 11, 1896.

An improvement in electric bells is described.

592,301. Multiple Switchboard. Milo G. Kellogg, Chicago, Ill. Original application filed April 27, 1887. Divided and this application filed November 12, 1890.

The first claim is quoted: In a telephone exchange system, the multiple switchboards of the exchange to which the same telephone lines are connected, two of said lines temporarily connected together at either of said boards into a closed circuit for conversation, and an electric battery in the central office connected in the circuit of said lines whenever and as long as they are so connected, in combination with test-receiving instruments, one at each board, each instrument being grounded on one side and connected to a switch-testing device on the other side, and test-bolts or contact pieces, one bolt on each board for each line, each bolt being connected to its line between the subscriber's station and the separable contacts of the line on all the boards, and the testing device at each board being adapted at the will of the operator to be brought into connection with any test-bolt at its board, whereby an operator at any board may connect her test-receiving instrument to the circuit of either line and determine that said line is in use for conversation.

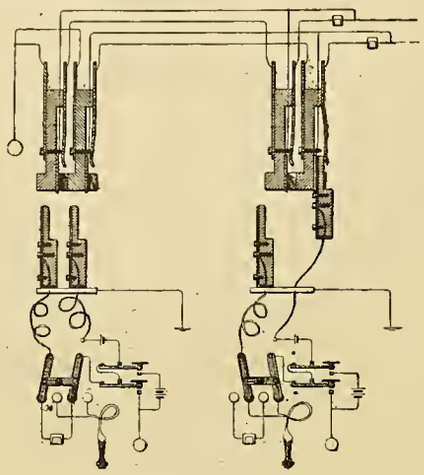
[The next patent issued, and all succeeding ones up to and including No. 592,415, bear the same title, "Multiple Switchboard," and are all issued to Milo G. Kellogg of Chicago, and assigned to the Kellogg Switchboard and Supply company of Chicago. The applications were filed in 1887, 1888, 1889, 1890 and 1891. The patents numbered 592,364, 592,367, 592,375 and 592,376 have been patented in one or more foreign countries.]

592,416. Spring-jack for Telephone Switchboards. Milo G. Kellogg, Chicago, Ill. Application filed April 1, 1893. Renewed December 30, 1893.

A spring-jack switch containing a contact piece in or along the switch-hole and a pair of contact pieces normally closed, and another pair of contacts permanently insulated from the rest and normally open, in combination with a loop-switch plug containing two contact pieces, each insulated from the other, and an insulated surface of the plug insulated from the plug contact pieces, the plug being inserted into the switch, and when inserted automatically opening the normally closed contact pieces and forming connection between the two contact pieces of the plug respectively, and the contact piece in or along the switch-

hole and one of the contact pieces of the pair of normally closed contact pieces, and the insulated surface of the plug pressing one of the normally open contact pieces of the switch into electrical contact with its mate.

[Patents numbered 592,417 to 592,425, inclusive, are granted to Milo G. Kellogg of Chicago, and entitled "Multiple Switchboard." All are assigned to the Kellogg Switchboard and Supply company. The applications were filed in 1893 and 1895, and patent No. 592,418 has been patented in France. In all, this remarkable series of patents to Mr. Kellogg includes 125 patents. It is undoubtedly the largest number of patents ever issued to one inventor in one day.]



NO. 592,301.

592,427. Cut-out for Electric Signal Boxes. Louis W. Miller, Rochester, N. Y. Application filed September 29, 1896.

The combination with an electric signal-box provided with a door and lock, of a cut-out arranged to be operated by the closure of the door, and a supplemental spring-actuated lock attached to the door and having a movable bolt adapted to prevent the closing of the door until retracted by the key.

592,431. Telephone Switchboard Apparatus. Frank R. McBerty, Downer's Grove, Ill. Application filed September 25, 1896.

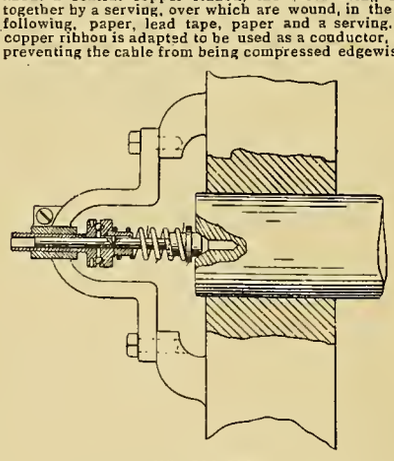
The combination with a telephone line having means for producing signaling current in the line, of a line annunciator connected therewith, a clearing-out annunciator also connected with the line, switch contacts actuated by the clearing-out annunciator in its response, and circuits controlled by the switch adapted to render the line annunciator inoperative.

592,432. Cut-off Relay for Telephone Switchboards. Frank R. McBerty, Downer's Grove, Ill. Application filed March 11, 1897.

This device has a straight core with a suitable winding, of pole-pieces for the core extending at right angles thereto and bending toward each other, an armature between the core and the pole-pieces overlapping the pole-pieces, a switch-spring parallel with the armature outside the pole-pieces and a normal resting anvil therefor, and a stud connecting the armature with the switch-spring.

592,441. Electric Cable. William R. Patterson, Chicago, Ill. Application filed August 20, 1896.

A flat electric cable, consisting of insulated wires wound about a central copper ribbon, the wires being bound together by a serving, over which are wound, in the order following, paper, lead tape, paper and a serving. The copper ribbon is adapted to be used as a conductor, while preventing the cable from being compressed edgewise.



NO. 592,502.

592,443. Automatic Electric Circuit Breaker and Closer. Edmund Pruckner and George Schindler, Newark, N. J. Application filed February 4, 1897.

Features are a vertically movable and adjustable core mounted upon a rod which is connected to a lever, and a vertically movable rod having a plug connected thereto and insulated therefrom, and two plates insulated from each other adapted for engagement with the plug, whereby they may be brought into electrical connection with each other, and a base-plate of insulating material for mounting the parts.

592,452. Pilot Lamp for Telephone Switchboards. Charles E. Scribner, Chicago, Ill. Application filed March 11, 1897.

The first claim describes the combination in a circuit of a source of current, a switch controlling the continuity of the circuit, an electro-magnet in the circuit and switch-contacts actuated thereby, a short-circuit of the magnet adapted to be closed by the switch-contacts when the magnet is excited, and means for retarding the movement of the switch-lever controlled by the magnet.

592,463. Electrical Resistance Device. Elliott E. Anthony, Detroit, Mich. Application filed February 23, 1897.

An electrical resistance composed of a concentric series of polygonal resistance coils supported upon a reel or skeleton frame electrically insulated from each other by insulating material at the corners and air-spaces between, and a sliding spring-jack in frictional adjustable contact between each pair of coils.

592,494. Telegraph Transmitter for Ocean Cables. David Lynch, New York, N. Y. Application filed March 16, 1895. Renewed April 8, 1897.

Magnets are used for closing currents in the line in opposite directions; local batteries are in circuit with the magnets; circuit-closers short-circuit the magnets, and there are means for automatically opening and closing the circuit-closers at predetermined intervals.

592,497. Contact in Shunt for Circuit Breakers. William M. Scott, Philadelphia, Pa. Application filed May 1, 1897.

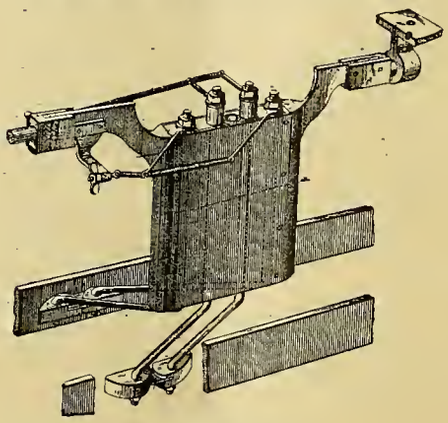
In a circuit-breaker the combination with the main contacts, of carbon contacts in shunt for final separation with metal plates yieldingly attached to the carbons adapted to overlap the opposite contacting carbons respectively, and to contact with the carbons upon the other sides from that of the carbon-to-carbon contact.

592,502. Support for Armature Shafts. William R. Thompson, South Norwalk, Conn. Application filed April 26, 1897.

With the supports of an armature shaft a yoke is secured in combination; a tubular screw-threaded shaft passes through the yoke, and a supplemental spring-operated shaft passes into it, and is adapted to bear on the armature shaft.

592,503. Automatic Electric Alarm Device. Paul V. Vandevelde, Corona, N. Y. Application filed July 26, 1897.

The combination with the frame and sash of a window, of an electrical alarm device comprising a contact point mounted in the frame, a spring brush mounted adjacent thereto and adapted to rest normally in contact therewith, the contact point and brush being in electrical connection with the circuit, whereby the circuit is completed when the brush is in engagement with the contact point, the brush being held out of contact with the contact point by the sash weight when the sash is in a closed position.



NO. 592,711.

592,505. Electrical Insulator. Wellington Barbour, Bar Harbor, Me. Application filed August 28, 1897.

There is an inner cylinder of glass or other suitable insulating material provided with an internal screw, and external projections; an outer covering of elastic material is provided with a groove.

592,524. Supply System for Electric Railways. Auguste Mégroz, Budapest, Austria-Hungary. Application filed April 13, 1896. Patented in Switzerland March 24, 1896; in Belgium April 15, 1896; in Italy May 11, 1896; in Spain May 29, 1896; in France July 3, 1896; in Sweden July 8, 1896; in Austria July 21, 1896; in Hungary September 30, 1896; in Germany November 9, 1896; in England December 12, 1896, and in Denmark December 31, 1896.

The first claim is given: In electric railways a single insulated main conductor, rocking feeders arranged at suitable distances apart, conductive connections between the feeders and conductor, and circuit-closers interposed in the connections and provided each with a stationary and a gravitating contact, the circuit-closers carried and rocked by their respective feeders to close and interrupt the feeder-circuit, in combination with a traveling current-collector adapted to take current from the feeders, and appliances independent of and traveling with the collector operating to rock the successive feeders to move the same alternately into and out of contact with the collector, and thereby alternately close and interrupt the feeder-circuit.

592,528. Electric Railway. Eben C. Crocker, Bridgeport, Conn. Application filed March 1, 1897.

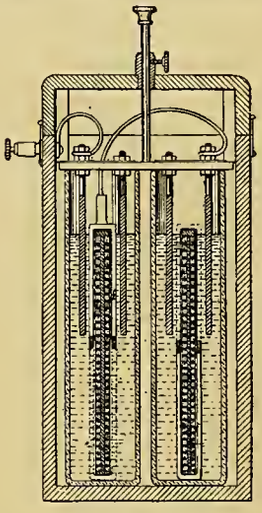
This railway system comprises bonded rails and cars capable of traveling thereon, each car carrying a suitable motor and controller-box, a continuous length of insulated rails between the bonded rails laid and secured in position with their abutting ends insulated from each other, and magnets carried in pairs at each end of the car and having their cores normally depressed with a spring action against the insulated rails, the coils of the magnets being electrically connected respectively with the cores and controller-box; insulated solenoids are located in the roadbed beneath the insulated rails, the armatures immediately beneath the latter and within the field of the magnets and carrying insulated contacts; connection is made between the solenoid cores and the armatures, whereby the elevation of the latter will bring the former within the magnetic field of the solenoids, the coils of the solenoids being electrically connected respectively with the contacts and a line wire.

592,551. Incandescent Electric Light Support. Ross L. Mahon, Duluth, Minn. Application filed July 17, 1896.

Parts enumerated are a base, a rod or arm mounted on the base and capable of universal movement with respect to the same, a collar rotatably mounted on the rod or arm, spring-clips carried by the collar and an incandescent lamp supported in the spring-clips.

592,565. Joint for Third Rails for Electric Railways. Patrick Haley and Paul P. Thompson, Chicago, Ill. Application filed March 22, 1897.

The joining plates are adapted to close the bottom and sides of the joint, and a good conductor is filled in between the ends of the rails and held therein by the plates.



NO. 592,722.

592,596. Contact Device for Electric Railways. Eugene R. Pommer, New York, N. Y. Application filed November 20, 1888.

On the roof of the car a trolley arm is attached to a support. This arm is so attached to its bearings that it can rock on either side of a transverse axis, and also on either side of a longitudinal axis.

592,600. Thermometric Electrical Circuit Closer. Giles H. Zeal, London, England. Application filed May 10, 1897.

A two-tube thermometer has circuit terminals applied thereto, with a mount carrying the thermometer, a fixed support or backboard to which the mount is pivoted and upon which it is adapted to be turned on its pivot in a plane parallel with the plane of the tubes to vary the heights of the mercury in the tubes, and thereby vary the distance between the mercurial column and one of the circuit terminals, whereby the circuit may be closed at varying temperatures.

592,610. Electric Motor Regulator. Felipe Vidal y Vilaret and David Belais, New York, N. Y. Application filed May 24, 1897.

There is a series of resistances, a movable contact arm and an electro-magnetic device actuating the arm, the resistances, arm and electro-magnetic devices being in series in the field circuit of the motor, and an escapement mechanism regulating the rate of movement of the arm.

592,703. Electric Conductor. Gorham Gray, Boston, Mass. Application filed December 4, 1896.

A conductor having a continuous core and an outer portion divided by longitudinally and annularly extending grooves, the core being of material harder than that of the outer portion.

592,711. Conduit Railway Trolley. William Luer, Chicago, Ill. Application filed January 4, 1896.

A frame is suspended from the bottom of the vehicle and adapted to swing thereunder; a series of rods is carried by the frame; contact blocks having link connections are supported by the rods; spring connections are provided between each pair of the series of the rods, with means for regulating the tension of the springs.

NO. 592,735.

592,722. Electric Battery. Frank M. Bell, New York, N. Y. Application filed May 18, 1896.

The element is formed of a lead negative plate provided with a body of peroxide of lead, one or more amalgamated zinc positive plates, a perforated sheet of insulating material extending over the upper end only of the negative plate and inserted between the positive and negative plates, an elastic band stretched over the perforated sheet and over the negative plate, and an electrolyte surrounding the positive and negative plates.

592,735. Apparatus for Electrically Treating Liquids. Fernando Jones, Chicago, Ill. Application filed February 23, 1897.

The combination with equidistant sinusoidal electric conducting sides of a non-electric conducting bottom, end pieces separating the sides, and an electric connection with each of the sides.

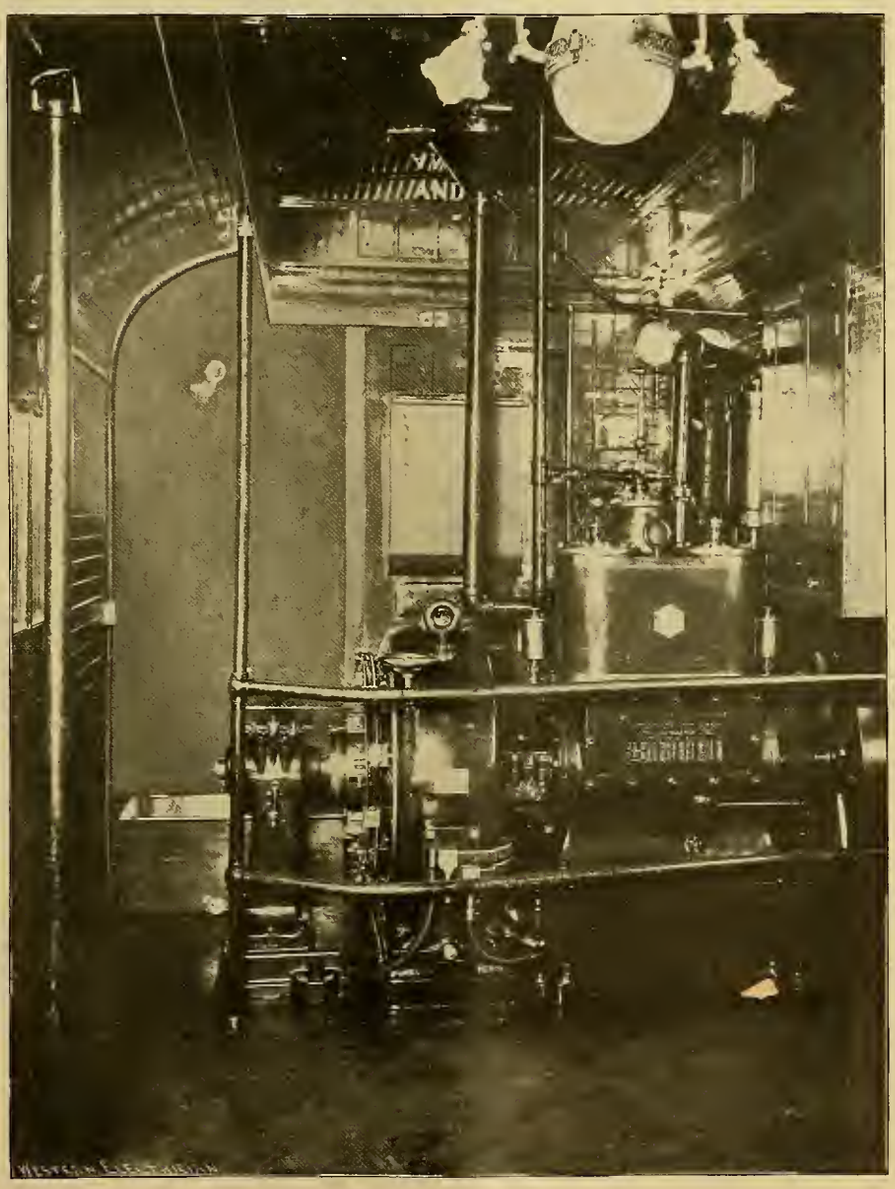
Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, NOVEMBER 13, 1897. No. 20

Electric Lights on the "Lake Shore Limited."

Each of the three principal railroad companies operating between Chicago and New York runs a crack "limited" train daily each way between these cities. The Lake Shore company, in conjunction with the Wagner Palace Car company, has lately begun the operation of four brand-new trains in its "limited" service, and these trains are very fine examples of the luxury now attained in railroad travel in the United States; indeed, they are said to be the finest trains in regular daily service in the country. The trains are duplicates of one another; two are always on the road and two are lying in the yards in New York and Chicago, where they are cleaned and restocked for the next trip. A fifth train will be turned out from the Wagner shops in Buffalo to go on the road when, one by one, the trains are withdrawn for the overhauling process necessary at frequent and regular intervals. The trains are elaborately finished and handsomely appointed, with rare woods carved and inlaid, rich hangings and carpets, fine furniture and beautiful metal work. There are drawing rooms, observation rooms, public and private dining rooms, a library, private apartments as well as sleeping berths, bath-rooms, a barber shop and commodious kitchen, and, of course, the whole train is vestibuled from end to end. Each train, as it pulls out of Chicago, beside the locomotive and tender, consists of five cars, in this order: buffet smoker and combination baggage car, New York 10 section and double drawing-room car, Boston 10 section and double drawing-room car, dining car and combined parlor and observation car. Coming west the train is heavier, and between Albany and Syracuse consists of eight cars. The trains leave Chicago at 5:30 p. m. and arrive in New York at 6:30 p. m. of the day following; leave New York at 5 p. m. and arive in Chicago at 4 p. m. of the next day.



ELECTRIC LIGHTS ON THE "LAKE SHORE LIMITED."—BAGGAGE-CAR PLANT.

In the forward end of each of the baggage cars of these trains is an electric light plant. One of these plants furnishes the subject of the illustration. The plant consists of an engine-dynamo driven by steam from the locomotive boiler. The steam passes through a 1¼ inch flexible coupling at the back of the tender, and is used at a pressure of from 70 to 80 pounds, passing through a steam separator before reaching the small engine. High-pressure steam for heating the train is also taken from the locomotive through the same connection, the lighting and heating of the train being in charge of a man who does nothing else.

The engine is of the Westinghouse upright enclosed type, rated at 30 horse power, with cylinder dimensions of 7½ by seven inches. It turns at 400 revolutions per minute, and the shaft is directly connected to the armature shaft of a 120 volt multipolar dynamo made by the Westinghouse company, which is easily capable of generating 150 amperes of current. This set is neatly painted and is placed across the car over the forward truck. A guard rail is provided to separate it from the space used for carrying baggage. An exhaust pipe leads up through the roof from the engine. The whole plant is very compact. Back of the engine-dynamo is the steam separator spoken of and an oil separator used in conjunction with the engine, the working parts of which run in water and oil. The main circuit switch, the field rheostat and the measuring instruments, with the steam gauge, are placed on the forward end of the car. The whole outfit, with the passage at the side of the dynamo, does not take up more than five feet of the depth of the car.

The train is wired on the three-wire system. The electrical connection between the cars consists of a section of three-wire conductor, perhaps three feet long, well insulated and taped. This is curved sufficiently to allow for the necessary play due to the motion of the train. This connector terminates at both ends in three plugs which are adapted to fit into spring-clip terminal boxes in the hoods of the cars. The connections are thus overhead, easily and quickly made or broken, and accessible at all times, whether the train is in motion or at rest.

Combination fixtures are used for the overhead aisle lights, as Pintsch gas is used after 11:30 p. m., when the electric lighting plant is shut down. But the berth or reading lights are exclusively electric. The arrangement of these is such that one lamp supplies two berths—that is, one lamp for two adjoining upper berths or for two lower berths. The lamp is set in the partition, and a rolling metal shade on each side is ingeniously arranged so that lifting it switches the lamp into circuit. However, the reverse motion does not cut out the lamp unless one shade is already down. Thus the occupant of one berth cannot be deprived of his light by the action of another passenger. He can pull down his shade and cover the lamp, but unless the other man is also through with the light it will continue to glow until half-past eleven, when the Pintsch gas is lighted ofr the general dim car illumination. Nearly all the lamps are of 16 candle power, but there are some 12 candle power lights and a few of 20 candle power. The berth lamps are nearly round and have a coiled filament doubly anchored to the base. They are supplied by the Edison Lamp Works. Clear glass lamps are now in use, but ground glass globes are to be substituted. With the maximum eight-car train, there are nearly 400 lamps connected with the electric lighting system.

With this system of electric train lighting the lights are independent of the motion of the train, so long as the dynamo engine is supplied with steam. It is not subject to the limitations, in this respect, of the axle-driven and storage-battery systems. But it is obvious that when the locomotive is taken away the lights will go out. There are two places—Elkhart, Ind., and Albany, N. Y.—where locomotives are changed during the running hours of the electric light plant. To provide uninterrupted light in this situation an arrangement is made to secure current from outside sources. When the locomotives are to be changed one of the connectors used between the cars is attached to outside terminals on the baggage car and plugged into a local lighting circuit at the railroad station. The main circuit switch back of the engine-dynamo is a double-throw switch, and when it is thrown over the load is instantly transferred to the outside source of supply. Then the locomotive steam connection is uncoupled; the fresh locomotive backs down; the steam coupling is again connected; the switch is thrown back and the outside electrical connection detached. All this is accomplished in perhaps three minutes, and all the passengers notice is the momentary "winking" of the lights at the instant the switch is thrown.

The Lake Shore electric train lighting service has been in operation only about a week and so far seems to be entirely satisfactory. It is thought that the locomotive boilers can make all the steam required to heat and light the train as well as pull it. That, of course, is an important question; and it now seems that the limit of the boilers has not been exceeded.

Military Telegraph Lines.

Gen. A. W. Greely, chief signal officer of the army, informs Secretary Alger in his annual report that at the close of the year ended September 30th the permanent military telegraph lines operated by the Signal Corps aggregated 802 miles in length, exclusive of the short cable in New York harbor. The principal work of the year was done by the Signal Corps in connection with the operations against the Arizona Indians, where highly satisfactory experiments were made with the combined telegraph and telephone apparatus devised by Capt. James Allen of the corps.

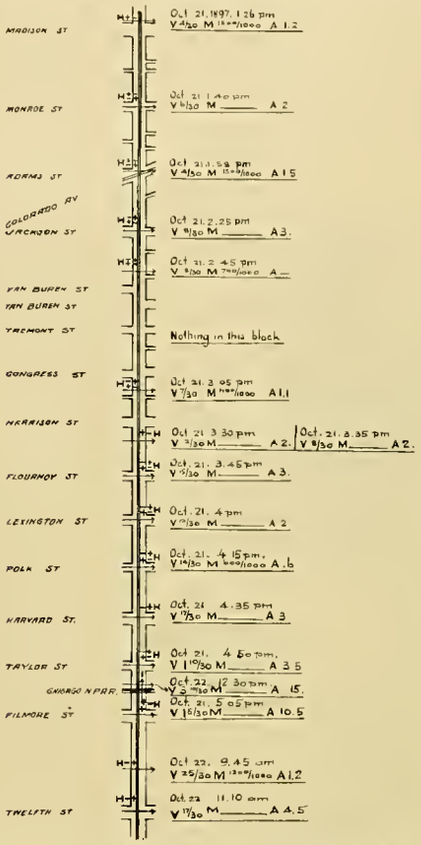
"An operator can easily carry a combination telegraph and telephone office," says Gen. Greely, "and while one soldier telegraphs a message another may, over the same wire, talk telephonically with another station, the distant receiving operators hearing only their own message. The outfit weighs only 16 pounds, including battery, and has been rigidly tested up to a distance of more than 600 miles and

is a pronounced success in its various capacities as a 'buzz' Morse telephonic and phonoplex instrument."

This was the most notable advance of the year, and its importance, the chief adds, is not confined to the field work of the corps, but its useful application may be made general.

Electrolysis of Buried Pipes from Escaping Street Railway Current.

Complaints have again been made that leakage of current from street railway returns is causing electrolysis of water and gas pipes in Chicago. The subject is receiving the careful attention of the city administration, and at the direction of the mayor City Electrician Ellicott has made a thorough investigation of the actual conditions in various quarters of the city. Usually the measurements were made at the hydrants or fire-plugs, but in some cases the tests were made by digging down to the



ELECTROLYSIS OF BURIED PIPES FROM ESCAPING STREET RAILWAY CURRENT —DIAGRAM SHOWING TESTS ON KEDZIE AVENUE, CHICAGO.

water pipes. In every case where the latter method was adopted, a greater current was detected than at the hydrant on the surface, the difference being accounted for by the resistance of the joints of the pipe leading to the hydrant. The accompanying diagram is one of a large number made for Mr. Ellicott. It shows the measurements made on Kedzie avenue between Twelfth and Madison streets. The letters have the following significance: H, hydrant; V, volts; M, milliamperes; A, amperes. From the reports made by the city electrician to Mayor Harrison the following facts are taken:

South Side.

"The tests have extended from Madison street to Sixty-sixth street on Clark street and Wentworth avenue. Between Madison and Forty-fourth streets the hydrants and pipes are negative to the rails, and in that condition there is no danger. The amount of current which they are carrying is but small, and, owing to the negative polarity, does not endanger them. South of Forty-fourth street the quantity of current which is carried by the pipes begins to increase. At one point we found as much as 46 amperes, which was an exceedingly dangerous amount of current.

"As soon as we reached Fiftieth street the railway company became aware of the condition of affairs and started to make connections with their return wires by putting in some additional bond wires, which immediately cut down this 46 amperes to 2½ amperes. But the pipes are positive to the rails, and 2½ amperes is a dangerous amount of current and liable to injure the pipes at the point where it leaves them to form a circuit with the rails.

"South of Fifty-first street about the same condition exists and there is an injurious amount of current passing between the pipes and the rails.

"I met the electrical engineer for the railway company, and he offered to assist me in any way possible in making the tests and placed their men or apparatus at our service, and stated that they would carry out any suggestions we have to offer with a view to overcoming the difficulties.

"On Wednesday afternoon [October 13th] I requested them to discontinue one of their long feeder lines extending from Twenty-second street to Fifty-first street, and allow us to make a test of the conductivity of rails which they use as a return circuit. I found there was a drop in potential between Twenty-second and Fifty-first streets of 12½ volts at three o'clock in the afternoon, when the load was comparatively light. We tested the drop in potential on Twenty-second and Thirty-eighth streets, which is just half way, and found it to be but 2½ volts, thus showing that the conductivity of the rails was much less between Thirty-eighth and Fiftieth streets than it was for the same distance between Twenty-second and Thirty-eighth streets.

"Upon investigation I found that the return wires, which should extend the full length of the system, branched off at Forty-seventh street and left nothing but the rails to carry the current between Forty-seventh and Fifty-first streets. There is also a bad railway crossing at Root street, and I think these two conditions are really the cause of the great drop in potential between Thirty-eighth and Fifty-first streets. You will note that while it is but 2½ volts between Twenty-second and Thirty-ninth streets, it is 10 volts for the same distance between Thirty-eighth and Fifty-first streets.

"The railway company stated that they would proceed at once to examine the bonds on the rails and decrease this large drop, and I think when they have done this it will do away with the dangerous amount of current which the pipes are at present transmitting.

"I have not tested any of the cross-town lines on the South Side, for the reason that the railway company has now had it presented to them that the difficulty really exists and there is no reason why they should not go over their whole lines and put the return circuit in proper condition and then advise us to make our tests.

"Upon looking into the matter, I find they have experienced trouble in other cities from pipes carrying current where large trolley systems are in use, and in some instances they have made contact between the water pipes and the rails to prevent injury being done where the current leaves the pipes, and at other places they have paid more attention to running a copper return wire of sufficient cross-section, while at other places it has only been necessary to properly bond the rails where joints are made.

"I feel quite sure that if the Chicago City Railway company will use proper bonding between rail and joints they will not have to put in much copper wire to use as return, as the rails are very heavy and in most instances have sufficient current-carrying capacity without shunting any current into the water pipes."

West Side.

"These tests were made on the West Side on the lines of the West Chicago Street Railway company. The tests start on Van Buren street at Charles place and extend west on Van Buren street to Kedzie avenue. There is also a section on Kedzie avenue from Madison to Twelfth streets.

"There are not less than 30 places where there is a dangerous flow of current from the pipes to the rails, and at some places there is an exceedingly dangerous amount of current. These most dangerous points are found between Twelfth and Madison streets on Kedzie avenue.

"There are but very few cars running on this line, and the indications are that, owing to an improper design and construction of some of the other lines, a part of the current is sent back to the power station over Kedzie avenue line, whereas provision should be made for it upon the lines which the cars are operated.

"I would recommend that the West-Chicago Street Railway company be required to re-bond all their rails in a satisfactory manner, put in the necessary copper wire for return current, and to bond the return wires and the rails at a greater number of points than they are at present. At present they make a connection between the return wires and the rails about every 1,000 feet. In the new construction the commissioner of public works is requiring, on my recommendation, that the return wires, where they are used, be bonded to the rails every 120 feet.

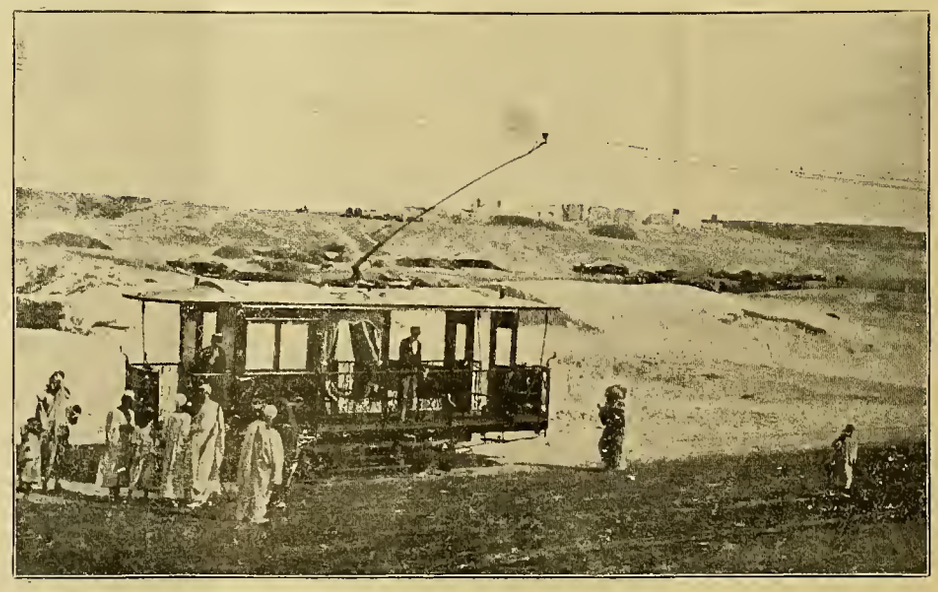
"I consider this matter of great importance, and the railroad companies can certainly make the desired changes and eliminate any danger without a very great expense.

"I do not think any serious damage has been done to the water pipes up to the present time, but from some of the tests which I have made on the West Side. I do not think that it will be more than two years before it will be necessary to make a great many repairs to the water pipes, which are certainly being affected at this time."

Electric Railway in Alexandria.

The land of the Pharaohs, the cradle of Egyptian civilization, has been invaded by electric power, and to-day the sleep of forty centuries is broken by the hum of the motor, and the Egyptian darkness is illuminated by electricity.

On September 11th the electric road between Alexandria and Mex was formally opened with great eclat, under the auspices of the khedive. His excellency, Ismail Pacha Sabri, governor of Alexandria, the French consul-general, representatives of the Russian and Spanish governments, with a host of other dignitaries, were present. At the appointed hour the khedive gave the signal to move. A writer in l'Energie Electrique says that it was with extreme difficulty that the crowd of young effendi and others was restrained from usurping the places of invited guests, so eager were the spectators to have a ride on the first train. Several thousand persons were present, and their shouts, combined with the noise caused by the stamping of feet and clapping of hands, were almost deafening. The entire length of the route the train was run at a comparatively slow rate, because of the crowds of children who climbed on everywhere that foot or hand could cling. The entire route was decorated for the occasion, and the train was greeted by parades of students and workingmen, who saluted it with national songs. A halt was made in the Arab quarter, and then the train proceeded into the desert, on its way to Mex, past an encampment of Bedouins, whose camels regarded the passing train



ELECTRIC RAILWAY IN ALEXANDRIA.—ON THE ROAD TO MEX.

with indifference, while the black, half-naked attendants showed as little interest as the beasts.

The central plant of the line is situated at Karmous, on the bank of Mahmoudieh Canal. Two Walker dynamos are actuated by two French engines. The gauge of the road is 1.44 meters, and the rails weigh 40 kilogrammes to the meter.

The coaches, like the French tramway cars, are divided into three compartments, with arrangements to allow of quick changes from summer to winter cars. The divisions are marked first and second class, and "Ladies Only." The road has 10 of these coaches, each furnished with two 25 horse power motors. The first round trip was made in about two hours, and on the following day the road was opened to the public, more than 8,000 passengers being carried. The trainmen managed to collect only about one-half the fares.

Niagara Falls has just made a five years' lighting contract with the Buffalo and Niagara Falls Electric Light and Power company at $84 per light up to 325 lights, the price to be $80 per light when the number in use exceeds 325.

Application of Electricity to Railroads Now Operated by Steam Power.[1]

By H. N. Heft.

Part II.

Third-rail and Return Circuit.

Our third-rail and return circuit experience will perhaps be of value to both street railway and railroad managers, as we have undoubtedly made a wide departure from established methods. We have solved a number of interesting problems.

First is the question of insulation. The third rail has a potential of 600 volts above the ground and rests upon creosoted wooden blocks dowelled into the ties, its eaves being only 1⅝ inches above the tie. Now it frequently happens that water accumulates two inches or more in depth over the ties, and, if it were not for our experience to the contrary, we would naturally suppose that, under these circumstances, the line would be directly short-circuited between the third and service rails through the water, the distance being but about two feet each way. Nevertheless, we have been able to operate our road without the slightest difficulty, when this has happened, and nothing unusual has been noticed at the station, nor has the electrical output, as registered by the recording wattmeter, been abnormal. At Berlin we have watched the ammeter closely when we knew the tracks to be submerged in two places 10 miles apart, during a heavy rainstorm, and have found that the leakage was almost imperceptible when both cars on the line were at rest and their air pumps out of circuit. At the same time the wattmeter was standing still. Of course, if a long length of track was submerged the leakage might become serious, but we have yet to learn how much is necessary to accomplish this result.

We aim to so connect our third-rail lines and the service-rail return as to have a practically complete metallic circuit of extremely low resistance, as far as possible disconnected with the ground. We do not believe in grounding our track, and though ground plates are placed at the station, connected to our generator, by far the largest proportion of the return current comes through the cables connected directly with the track, the percentage coming from the ground plates being extremely small.

The joints of the third rail are bonded by long copper plates, firmly bolted to both sides of the joint, 16 bolts being used in all. These copper plates are tinned before being put into position. Owing to the large area of contact surface, the presence of rust on this surface does not materially interfere with the conductivity of the joint, as shown by accurate tests.

The service rails are bonded with the greatest care, four copper leaf bonds, having a cross-section of copper equal in conductivity to that of the rail, being used. These bonds are inserted in the base of the rail instead of the web, so as to prevent breakage through play at the joints. The copper leaves are cast into end-piece blocks in such a way as to weld them thoroughly together in the blocks. The latter are formed into a hollow cylinder, one inch in diameter, which passes through a hole in the flange, and by which a large area of contact is secured. Tapered pins are driven into the inside of this cylinder from the top of the flange, and the connection made is very perfect. Careful tests have shown that the joints of both third and service rails have now a slightly greater conductivity than an equal length of the rails themselves.

A few words about the danger of the third-rail system would be, perhaps, in order. There have been many cases of people who have stepped from the ground to the third rail without feeling the current, and anyone can step upon it from a dry tie without the slightest effect. On all except wet days, our employes work about it without trouble, avoiding, of course, putting themselves in direct contact with both service and third rails, but not infrequently "monkeying" with the current in such a way as to get shocks of more or less severity in a sort of horse play. On wet days, they refer to the third rail as being "lively," and are inclined to let it alone. Many of our employes have, however, received the heaviest shock possible to obtain, time after time, and care little about it, though those who are more influenced by electric shocks than others are sometimes thrown off their feet, but recover fully in a few minutes. We do not say that the third rail has no dangers, but we do not consider the danger as being at all serious or one which should interfere with the extension of the system.

As a result of exceptional care, which we have taken in bonding our third and service rails, we have found it unnecessary, in any third-rail work so far done, to use copper feeders, in spite of the fact that we are obliged to transmit current from Berlin to Hartford, a distance, as before stated, of 12.3 miles, straight away from the power station. This work is made up as follows: From Berlin to New Britain, a distance of three miles, there is a complete double-track electric road with two 100 pound third rails and four 74 pound service rails, all most carefully bonded as described above. From New Britain to Hartford, a distance of 9.3 miles, there is one complete electric track, with 100 pound third rail and 70 pound service rails, all carefully bonded, in addition to which we have connected to the service rails of the electric track the rails of the second track, paralleling this the entire distance, at various places, in order to get the benefit of whatever conducting power there might be in this track connected only by its fishplates at the joints. As a result of this work, we are able to run two trains of 52 tons each on the New Britain and Hartford line with an average loss of but 26½ per cent. The current output of the station at such a time averages about 300 amperes, with a maximum flow of about 700 amperes at a pressure of 600 volts. Of course, if the service were heavier, so that more cars would be required, it would undoubtedly be necessary to reinforce the third rail with feeders.

ELECTRIC RAILWAY IN ALEXANDRIA.—TERMINAL OF THE ROAD AT THE STOCK YARDS.

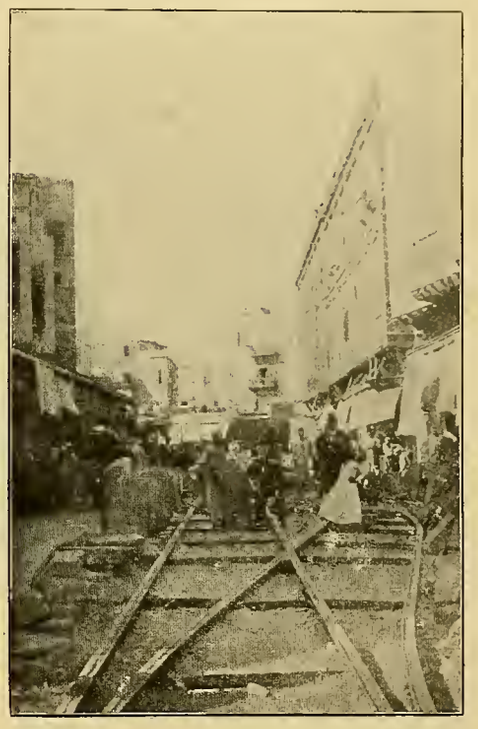
ELECTRIC RAILWAY IN ALEXANDRIA.—THE ARAB QUARTER.

Cost of Power.

In our Nantasket Beach station we have installed two engine-generator units of 800 horse power and 550 kilowatts capacity each. The steam is supplied by eight boilers of 200 horse power rated capacity each. On heavy days both these engines are required, but on ordinary days but only one, and this is not fully loaded, the average loads being perhaps one-half the maximum.

In the Berlin station we have installed two engine-generators of 1,200 horse power and 850 kilowatts each. The steam is supplied by 10 horizontal tubular boilers of 200 horse power each. One unit only is required in the practical operation of all the cars on the Berlin and Hartford lines, and the average power output is hardly one-fourth of the maximum capacity.

In both stations our aim has been not to follow out any engineering fads, but to provide apparatus proved by long experience to be of the most simple and durable character.



ELECTRIC RAILWAY IN ALEXANDRIA.—ROAD CONSTRUCTION.

We are now running our Nantasket plant condensing and our Berlin plant non-condensing, the loads in the latter being too light to make condensing profitable.

In spite of the fact that these general conditions of operation do not point to a low cost of power, because of the fact that we are working neither station at anywhere near its full capacity, I suppose we are, as a matter of fact, producing power more cheaply than can be done in any power station in the country using coal as a fuel, the reason being that we are burning sparks. "Sparks," as we are accustomed to call them, are the half-consumed coal dumped from the extension fronts of locomotives at the company's various roundhouses. Nevertheless, there is a great deal of steam-generating value in these sparks, as we have found by experience, and they are being carried on the company's cars to our stations at Berlin, Nantasket and Stamford, and charged to the electrical operation at the cost of freighting (including the usual profit to the company for transportation), plus the cost of loading and unloading, a total charge of 70 cents per ton delivered.

In order to burn these sparks we are obliged, of course, to make some changes in the furnace arrangements, chief among which is provision for the introduction of live steam under the grates, forming a blower or forced draft as well as providing the water which, in decomposition, furnishes the oxygen and hydrogen gases which increase greatly and facilitate in combustion of half-burned coal and add enormously to the furnace heat. We originally supposed that some form of shaking or self-cleaning grate would be necessary in burning sparks, but have found in practice that with ordinary grates, together with the steam blower, there is no difficulty. In our experimental days it

was thought that it might be necessary to use a proportion of ordinary soft coal with the sparks, and did so for awhile, but it was not long before our firemen were educated to burn sparks only, with entire ease, and no other kind of fuel is now used by us. Of course, we have to use a greater weight of this half-consumed coal than would be the case with new coal, but still the economy is great, as a good quality of run-of-mine coal costs us, in Connecticut, about $3 per ton delivered at power station.

A few figures as to the cost of power at Stamford may be of interest. This station furnishes current for our street railway system at Stamford and for lighting our railroad stations with 350 incandescent lamps. We are operating one engine only, of 500 horse power total capacity, direct-connected to one 300 kilowatt generator. In the boiler room are six 200 horse power boilers. For the first six months of full operation with sparks only, the total cost of fuel for this station amounted to three mills per horse power hour or four mills per kilowatt-hour. For so small a station and one where the average amount of power developed is hardly more than one-third the rated capacity of the engine, I believe this to be a low figure. We have recently made, for our own information, for use in larger plants, special tests of the cost of power developed in this way, using for this purpose a water rheostat, in order to load the engine up to more nearly its full capacity. As a result of these tests, we find the cost of fuel for power, with the use of coal, to be 3.2 mills per horse power hour, 4.2 mills per kilowatt-hour. With the use of sparks the cost is reduced to 1.9 mills per horse power hour or 2.5 mills per kilowatt-hour.

At our Nantasket power station this season the cost of fuel, with the use of coal, has averaged 4.2 mills per horse power hour or 5.6 mills per kilowatt-hour, while with the use of sparks, the cost has been 2.1 mills per horse power hour or 2.8 per kilowatt-hour.

As before stated, our Berlin plant has not been run as economically thus far as it will be when a greater load is put on the engines, and it will seem to be in the interest of economy to run compound condensing. At this station the cost of fuel, with the use of coal, has been nine mills per horse power hour or 12 mills per kilowatt-hour. Using sparks as fuel has reduced this cost to three mills per horse power hour or four mills per kilowatt-hour.

It is very difficult, of course, if not impossible, to make any direct comparisons between the cost of motive power for electric railroading and that for steam railroading, on account of the different way in which the trains are made up. The best criterion would be the cost of motive power per ton-mile hauled, but even here the results would be of little value on account of the wide difference in conditions, and, as a matter of fact, we have never attempted to make such comparisons.

I have tried to give you, as briefly as possible, some of the results of the pioneer work which the New Haven company has been doing in heavy electric railroading. They are roughly stated, and we cannot pretend that they are in any way conclusive as affecting general railroad practice. For ourselves, however, we have formed some definite ideas as to what is possible for us to accomplish, and our plans for the future are being made with great care by President Clark and the board of directors, with the intention of dealing with the new transportation conditions which confront us in a broad-minded and progressive way. It is felt that a great transportation agency of this character owes it to the public from which it has obtained its franchises to furnish the best possible service and to make the most of the natural advantages which it possesses.

There will always be room, doubtless, for railroads of two characters, the one operating on a purchased right-of-way, where trespassers can be kept away and high speed attained, and the other operating on streets and highways, where passengers can be taken up and let off at their own doors. It is possible that, in some thickly settled districts, such as are found in New England and the Middle states, where population groups almost touch each other, these two classes of service may occasionally be performed by the same agency, but there is no reason ordinarily why there should not be the most amicable and friendly relations, and not infrequently of a business character, existing between steam railroads and street railway companies.

Discussion.

G. W. Palmer, Jr., Fall River, Mass.: I ask Mr. Heft what the costs he has given us represent—the total cost of power or cost of fuel only?

Mr. Heft: I stated plainly that it was the cost of fuel only.

Mr. Palmer: Can you give us any figures which will show us the total cost of power per kilowatt-hour or car-mile?

Mr. Heft: That would depend entirely on the conditions at your station. No two stations would have the same conditions. At Stamford you can notice that our power costs us a great deal less, because we are running nearer to the normal capacity of our engines. At Nantasket the economy is not so great, and at Berlin, where we are only running the high-pressure side of the engine, it costs a great deal more. This is true also of the labor. The labor where the large engines are costs more than it does with the small engines, where you are running away below your normal load. If we were running our Berlin station up to its normal capacity, we would show a greater economy in fuel and labor than in the other power stations, because there is a certain fixed charge which we are subjected to at all stations, and the amount of that depends on the size of the station and the number of units.

Mr. Palmer: I appreciate that what you say must necessarily obtain, but what I wanted to find out was whether you had at hand or could give the cost for any one particular station.

Mr. Heft: We have that information in our office. I did not put it in this paper.

Mr. Palmer: It seems to me that it would be very interesting for some of us who are operating street railway power stations to be able to compare our cost of production of power with the cost of production of power in these plants which have so recently been fitted up with everything of the latest type, and I should like to be able to compare some of the figures which we have made with some of those which the New York, New Haven and Hartford have been making in their stations. For instance, the total cost per kilowatt-hour delivered at the switchboard, including all expenses which should properly come in—taxes, insurance, interest, labor, supplies and everything else chargeable to it.

Mr. Heft: I will say to the members of the association that we will very gladly furnish any of this data that you ask for, upon application at our office. We will supply any of our plans, maps or data sheets. We have nothing that there is any mystery or secrecy about, and we will be glad to place it at the disposal of any member of the association.

J. K. Newman, New Orleans: What is the cost of the sparks?

Mr. Heft: I stated that to be 70 cents for a ton of 2,000 pounds. These figures are based against coal costing $3 a ton. While the sparks do not cost our company anything (it is really an expense to get rid of them, as every steam railroad man knows), we pay our motive power department of the road the cost of handling and loading and the freight department the freight between the points where it is loaded and our power station.

C. K. Durbin, Denver: Can you give me some idea of the relative cost of construction of the third-rail system, as compared with the overhead and feeder system, in this case?

Mr. Heft: I think, if I recollect the figures aright, that the third-rail construction costs us, for the third rail, bonding of the rail and cables at the grade crossings and bonding of the surface rails, about $3,000 per mile. Figured against our cost at Nantasket, it is about one-half, if I recollect the figures rightly.

Electrically Operated Tools in Shipyards.

An interesting and recent application of electrical power to portable machine tools is, according to l'Electricien, to be found in an Austrian ship-building plant. Perhaps there is need at some far-off point in the yard for a drill. A portable motor is trundled down to the locality designated, and a pair of wires led from the generator in the dynamo room to this peripatetic instrument. A flexible drill is perhaps necessary, but this does not hamper the work. When the switch is turned the man who sits in the boiler (Fig. 1) accomplishes his work readily, quietly, and, what is of no small account, without being annoyed for lack of shop room, for there may not be another piece of machinery or a workman within several yards.

An important installation of this nature is in the arsenal at Trieste, furnished through the manager of the Austrian Lloyds, who states that the shops under his control can now furnish electrical machinery by which a marine cylinder weighing 11 tons can be finished ten days sooner than by former processes. The advantages he claims are three—lightness, simplicity and ease of transportation. This gentleman recently exhibited no less than six different models of drills and countersinking machines. The first weighs 101 kilogrammes, is of one horse power and drills holes 25 millimeters diameter. It is mounted on two wheels and is easily handled by one person. It has a telescopic shaft with two universal joints, and is readily adaptable to all conditions required of it. The second is similar to the first but weighs 203 kilogrammes and is capable of cutting a hole of 37 millimeters. The motor is of 1½ horse power.

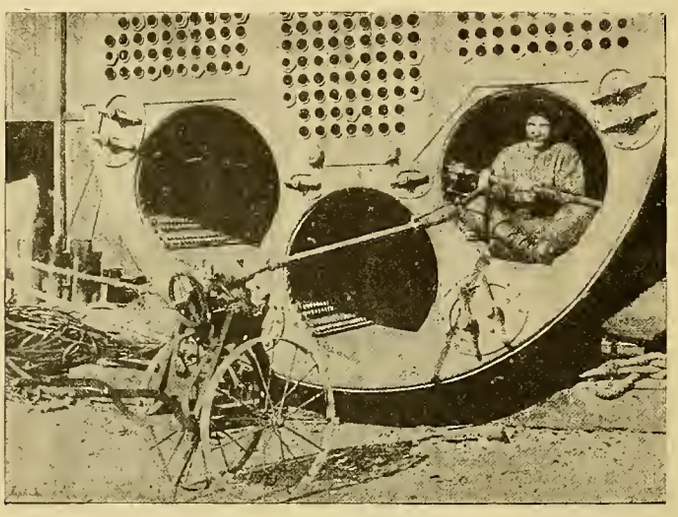


Fig. 1. Boiler Work Outside the Shop.

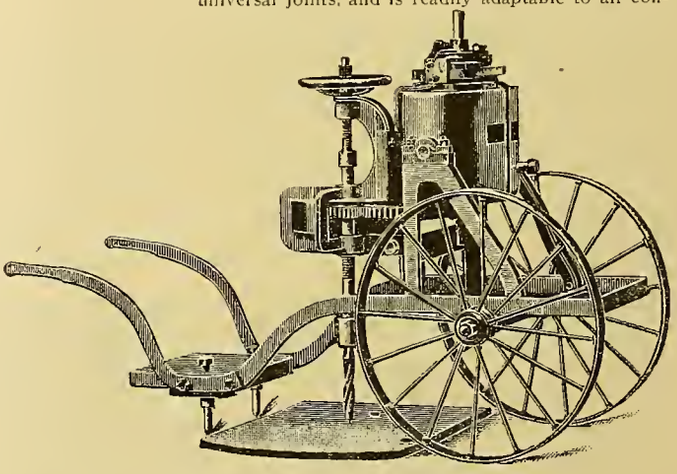


Fig. 2. Bridge and Armor Plate Work Outside the Shop.

ELECTRICALLY OPERATED TOOLS IN SHIPYARDS.

The third type is especially for marine work, has a motor of one and a half horse power, and an upright shaft driven by conical wheels. With this machine a single man can drill 400 holes in plate of one centimeter thickness, and the same machine can easily countersink 800 to 1,000 holes per day. Fig. 2 will illustrate the action of this machine. The workman handles the drill much as if it were a wheelbarrow. The drill is withdrawn by means of the wheel above, and then changed to the new work. It is far easier to move the machine than the plate. It is the old problem of Mohammed and the mountain. The arsenal shops have six of these machines in constant use, working on bridge iron. A second type of this machine has capacity for cutting 82 millimeter holes and has a rating of three horse power. This is especially for armor plate. In the construction of warships and other large vessels the plates are so unwieldy that M. Kodolitsch conceived the idea of moving the punching machine, rather than the plates. Two men are required to operate this, which is of 1½ horse power, and the reduction of expense is about 15 per cent.

A boring and mortising machine is another of this facile inventor's applications of electrical energy. This is a most important addition to the outfit of a shop of this character. The truing-up of a journal and the fitting of heavy eccentrics is extremely simplified, and far more readily accomplished by means of this portable machine, besides doing away with the necessity of either carrying the shop to the vessel or hauling the latter to the shop.

Besides the above there are applications for enlarging the bolt holes in repairing or changing the journal seat of a shaft, for boring a cylinder, for casing it, for fitting the boiler flues, for riveting by a succession of taps at the rate of 2,400 blows per minute, a rapidity which insures the perfection of the work while the iron is still hot. A pump, a windlass, a ventilating fan and a crane, all portable, close the list, if there are omitted saws, winches, elevators, both freight and passenger, all of which are actuated by electricity.

Power Distribution and the Use of Multiphase Current Transmission for Ordinary Street Railways.[1]

By Maurice Hoopes.

The subject that has been assigned to me for discussion is one that has received considerable attention of recent years. Aside from the demands of what is usually considered steam railroad service, the business of the ordinary urban and suburban railways has grown lately in a way that requires some means of augmenting the usual method of power distribution. Lines have been extended to greater distances from power stations, and traffic has increased on lines which always have been remote from their points of power supply. These conditions have arisen at places where disadvantages of location or lack of sufficient load would render additional power stations unprofitable. To meet such demands, several methods have been devised. The consideration of the comparative merits of these systems is the principle purpose of this paper. Before undertaking this task, however, the writer desires to discuss some of the conditions met with in the operation of the ordinary 550 volt distribution system. Some of the points raised have been frequently made. For these, an apology is offered in advance, the excuse being that they are sufficiently important to bear reiteration.

The usual electric railway distribution system, with its copper network as one, and its iron network as the other half, offers rather more complicated problems than does the ordinary form of all-copper circuits. The latter system is symmetrical, whereas the former is likely to have greater resistance in the copper than in the iron portion. A rule that holds good of both systems is that the maximum benefit in reduction of total resistance, due to the addition of a given amount of conductor, results when the addition is made to the parts in which the drop is greatest per unit of length. An observance of this rule is important in adding to distribution systems. This demands a carfeul analysis of existing conditions. Before adding feed wire to a railway circuit, it is important to know the drops, under usual load, of the parts of the circuit. These may be found by the use of pressure wires, or by short-circuiting the trolley wires to the rail, and pasing a given current through the circuit, measuring the total drop and deducting the calculated overhead resistance from the total resistance thus found. Private telephone lines serve the purpose of pressure wires to measure track drops, and public lines connected through the exchange may be used without interference with the service. An exception to the general rule that the copper should be added to the part of the circuit showing the greatest resistance is the case of a poorly bonded track that may show less resistance than the overhead. Reinforcing such track with overhead copper connected to each end of all special work may result in the greater decrease in the total resistance of the circuit. This is really a special application of the general rule, rather than an excepton to it, however.

Means for regular and easy measurement of track joint drops should exist. For tracks having frequent high-resistance joints, there is no better way than by walking over it with a low-reading voltmeter connected to prongs on the end of a stick, that it may be bridged across joints. For detecting poor joints in good track, where they are far apart, and for the general inspection of the condition of track wiring, a car is convenient. A box trailer with each wheel insulated from all others, and a voltmeter connected between the two wheels on each side of the car, may be used. A third meter connecting the two opposite wheels will indicate defects in cross bonding. The writer considers that it is unnecessary to complicate the measurements by attempting to measure the resistance of the joint. His experience is that, if a bond is loose enough to have abnormal resistance, it will get worse rapidly, and show excessive drop with even small amounts of current. It behaves very much as did the little girl, and is either "very, very good" or "horrid."

It is universally recognized that the maximum efficiency is obtained from a distribution system when it is operated as a whole, and not divided into sections. The liability of accidents to railway trolley wires makes it necessary to separate them in such a way that trouble at one point will not block the whole road. These sections should be as few as possible, while accomplishing the purpose for which they are designed.

Where one road has two or more power stations, the sections approximately equidistant from each of the two stations should be connected with both. They may then serve to equalize load between stations, the common section being cut loose from the station needing to decrease load. Two feeders to such a station, one from each station, constitute a tie line between stations. If desired the potential may be raised in one station to a point that will deliver current into the other. Unless the drop in the combined feeders is excessive, it will probably be safe to allow the section attached to take the increased potential. Tie lines between stations which serve none but emergency purposes are expensive, especially if the stations are distant from each other.

Where the ordinary methods of distribution are not applicable because of the prohibitive amount of copper necessary, some one of the following systems is commonly used to care for the particular section:

1. A special generator run at increased voltage and usually over-compounded as much as possible, handling the section and no other load.

2. A booster, consisting of a series-wound generator, connected in series with the feeder as it leaves the main station bus. The field turns of this generator should be such as to make the electromotive force of the armature as nearly as is possible equal to the drop in the feeder, throughout all ranges of current.

3. The three-wire system, requiring the division of the section into two. One-half is then supplied from the regular bus, and the other from a special generator, with the polarity reversed, to bring the trolley wire opposite in potential to that of the rest of the system. The trolley wire should be so divided into the two half-sections as to leave, as nearly as possible, equal loads on the two at all times. With this arrangement the current in the track is only that flowing from the cars on one half-section to those on the other. If these half-sections are located near each other, this path through the track is very short. For this reason, it is usual to make one track of a double-track road one half, and the other track the second half-section. Unless conditions are such that the cars are likely to be bunched on one track, this seems the better way of dividing. In addition to conducting current between cars, the track has to conduct back to the power station the excess in current used on one half-section over that used on the other.

4. The alternating current transmission system, desirable for railroad work, consists of high-voltage multiphase generators (or low-voltage generators with step-up transformers) in the main station, connected with one or more sub-stations containing step-down and rotary transformers. There are some half dozen such systems in use in this country, of which the best known are those from Lowell to Nashua, and from the station of the Niagara Falls Power company to Buffalo.

With any of the foregoing systems the storage battery may be applied as an auxiliary. In a railway power station a battery is useful to the extent that it improves the station capacity and fuel economy by removing the immediate fluctuations. The writer considers that there are few instances where a battery can be installed, with resultant profit, where its function is the storing of power one hour for use the next. Except with very short time peaks, the battery costs as much as the additional generating apparatus. Particularly in small stations, however, there is such variable load that it is impossible to average full load from the station for a period of time, because of the inability to handle the very short time overloads that such an average load demands. In such a station a battery may result in a considerable increase in station capacity, and, by allowing the engines to operate at practically constant loads, reduce the fuel consumption greatly. While a battery may do these things in the station, it may do even more, remote from the station. In the latter location it will keep the potential near it practically constant, and will also maintain uniform current flow between the station and the particular point, thus adding the advantages of regulation and greatly increased copper efficiency.

One side of the story makes a pretty good case for the storage battery; unfortunately, the other must be told. The first cost of a battery is so very great that reasonable interest and depreciation on the amount invested will more than consume the apparent saving, in many cases. Especially is this so in the case of a battery located on the line, where it has been shown that the gross saving is the greatest. This is true because it requires a very much larger investment in battery to care for the load variations of a given station if the batteries must be divided up among several sub-stations, the load factor of each of which is necessarily lower than that of the main station. The sum of the maximum variations of the several stations is always greatly in excess of the maximum variations in the main station. If, however, a power station were to be located at a considerable distance from a single center of distribution, through which all feeders from the station passed, it is quite probable that a battery placed at the latter point would result in a net saving, due to its giving each, the station and copper, a uniform load.

When it becomes necessary to select from the foregoing list the most suitable system for a given case, there are many conditions to consider in the decision. Either of the first three, the special generator, the booster, or the three-wire system, may be arranged with the apparatus in any railway power station, assuming that it includes a reserve generator of the necessary size. It is better to use standard railway machines for these purposes, and, if possible, to arrange the station so that any one of the regular station machines may be used. It frequently happens that one or more sections of line fed from a certain station have copper enough leading to them to care for them properly at all times, excepting a few hours on each ordinary day, and for longer periods on heavy days. While the work may be quite variable at times of light load, when the load increases it becomes more nearly uniform. Such sections may be satisfactorily supplied over the copper designed for the lighter load, by raising the voltage on the station end of the feeder during heavy loads, Usually, the margin in the field rheostat will allow the increase of voltage on any one of the generators to a point considerably above the normal. When this is not so it is possible that the generator speed may be increased, unless limited by the requirements of safety in the driving engine.

In one or both of these ways it is often possible to get from 700 to 750 volts from a standard 550 volt machine. This increase enables the heavy load on the section to be handled very satisfactorily. The voltage at the feeder end necessarily varies with the load, and with ordinary fluctuations there may easily be 100 volts difference between the minimum and maximum. A recording voltmeter placed at

[*Continued on page 278.*]

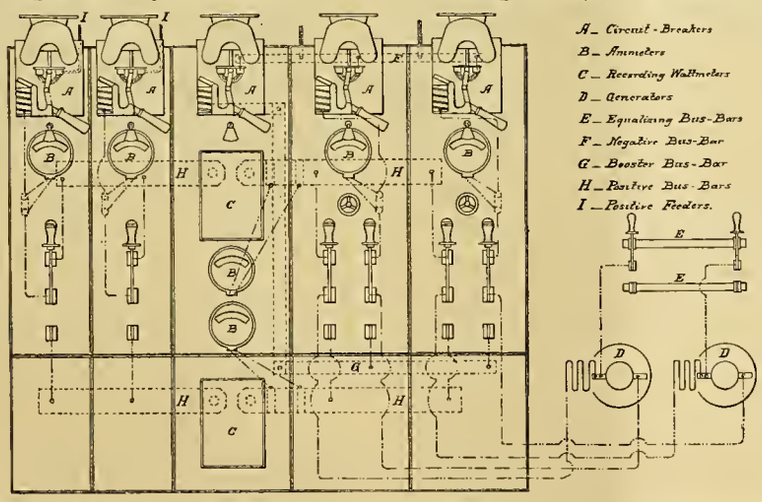


FIG. 1. POWER DISTRIBUTION AND THE USE OF MULTIPHASE CURRENT TRANSMISSION FOR ORDINARY STREET RAILWAYS.—DIAGRAM OF SWITCHBOARD FOR USING SPECIAL GENERATOR AS BOOSTER.

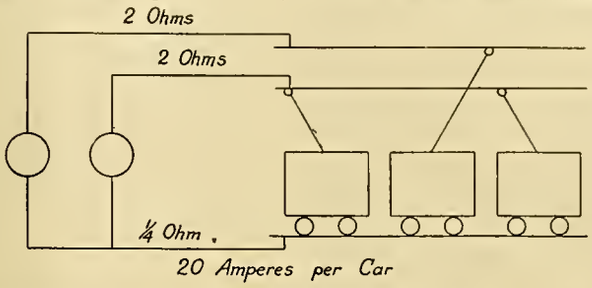


FIG. 2. POWER DISTRIBUTION AND THE USE OF MULTIPHASE CURRENT TRANSMISSION FOR ORDINARY STREET RAILWAYS.—DIAGRAM OF UNBALANCED THREE-WIRE SYSTEM.

1. Read before the American Street Railway association, Niagara Falls, New York, October 20, 1897.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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THOMAS JANSEN.

Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

State of Illinois, County of Cook—ss:
Frank Foster Kenworthy being duly sworn deposes and says that he is a resident of the city of Chicago, in the county of Cook and state of Illinois, and that he is the superintendent of the binding department of the Electrician Publishing company, the publishers of the Western Electrician; that he was present at and superintended the binding of No. 24 of Vol. 20 of the Western Electrician, issued on June 12, 1897, and that there were sent out by actual count 20,000 complete copies of said Western Electrician of the volume and number above specified.
And further this affiant sayeth not.

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It is anticipated that the Allen bill will be tested when the North Chicago Street Railroad company attempts to transform the Evanston avenue horse-car line into an electric road. An application has been made by the company for a permit from the city, although the corporation claims the right, under the Allen law, to make the change whenever it sees fit to do so. It is believed that the present administration will attempt to prevent the change if the corporation counsel can find grounds upon which to make a fight.

Perhaps it isn't necessary to dwell upon the lessons of the Washington street tunnel fire in Chicago, because, as we learn, the sufferers—not the citizens dependent on the service, but the owners of the electrical circuits—are taking steps to secure better construction in the future. But possibly in other out-of-the-way corners in Chicago, and other cities there are still wooden-encased wires carrying heavy currents of electricity or liable to come in contact with such wires. If there are such, the recent fire is a reminder of the possibility of danger ahead which, with due warning, may now be averted.

It is greatly to be regretted that in their anxiety to dispose of business at the recent Niagara convention the members of the American Street Railway association failed to give some of the papers read on that occasion the consideration they merited. In the case of the article on storage batteries, a general discussion would have resulted in bringing out much interesting information upon this important subject, but the restriction prohibiting the participation of others than members in the proceedings precluded the possibility of such a result. There were several men present who had valuable experience in the use of storage batteries, and they would willingly have given the association the benefit of their knowledge, but it was decided not to hear them. Mr. Hoopes' excellent paper was another example. Had engineers of experience been permitted to discuss this contribution, its value would have been greatly enhanced, as there were many points merely touched upon by the author, with the evident purpose of leaving them open for discussion.

The association as a body seemed to fear that the admission of manufacturers' representatives and engineers to the floor of the convention would detract from the dignity and importance of the meeting, while as a matter of fact the opinions and suggestions of these experts would have added greatly to the value of the proceedings. The leading technical organizations of the country are glad to avail themselves of the ideas of these experts, and frequently papers are presented before these bodies discussing what might almost be classed as commercial problems. Yet no one suggests the idea that the standing of these organizations is lowered in consequence. The street railway meetings in the early days of electricity were interesting because of the spirited discussions of advocates of the different methods of propulsion then appearing. It would seem as if the organization was hardly in position to dispense with the services and opinions of the experts who are engaged in improving and perfecting present methods.

Congo negroes have a method of telephoning which is not in interference with anything known to Bell or Reis or any of the other numerous "original inventors" of that wonderful system of transmission of sound. It is not an electric telephone, as the fundamental base of the system is a drum, the diaphragm being made of the skin of the native antelope stretched over a rude frame of cross-sticks. The device is made in as many forms and sizes as its various uses demand. For instance, there is a huge affair which is only beaten in case of war, and is displaced by a more pacific instrument which sounds when peace is declared. There are birth drums and funeral drums, marriage drums and dance drums, and drums for sounding official and commercial messages. The intelligence is conveyed by the method of handling the sticks, something after the drummer code in the army, but far more extensive and complicated. The native is capable of reading by sound and readily distinguishes between the good and evil portent of the message,

A recent traveler in the Congo country, according to l'Electricien, says that when Inspector Fivé on one occasion arrived at his post after a trip in the country, with the commissary, he was hungry and tired and had no means of satisfying his needs. When four leagues away from his destination he requested the resident chief to notify the Basoka authorities of his approach. As the inspector and his attendants left the station the drum was beaten, and a response came from the next point, from which the signal was repeated by relays to its destination.

Arrived at the station at midnight the travelers found supper hot and waiting, and, on inquiry, learned that the drummer had received this message: "Evening, boula matari (inspector or governor) will arrive hungry."

On another occasion the steamer having the inspector on board was billed to remain some minutes at Basoka, and a message was sent ahead to have the table servants dressed in uniform, on the steamer's arrival, for the purpose of having a photograph taken. The inspector was met by the military contingent, which gravely saluted him with "present arms." Inquiry disclosed the fact that the drummer had ordered the servants of the state instead of the servants of the table to present themselves.

Like the old-time telegraphers and the railroad dispatchers of this country, these drummers have occasional meetings for rehearsals and for enlarging their repertoire.

The culmination of the troubles in which the city of Philadelphia has become involved through mismanagement of its gas-works has at last been reached, and it has been decided to lease the property to a private corporation. The reckless extravagance practiced in this department of the public service was exposed in a recent investigation, and, as a result, prominent citizens of all parties, who had before been favorably disposed toward the municipal ownership of such enterprises, joined in a movement to abolish the present system and grant a franchise to a private corporation. On Monday the ordinance providing for leasing the city gas-works to the United Gas Improvement company of Philadelphia was passed by the Common Council, the vote being 78 to 52, and the following day the Select Council approved the measure by a vote of 25 to 13. It was announced that the mayor favored the proposition and would sign the franchise.

This will effectually dispose of the city gas-works of Philadelphia, which have been cited for years as an example of the practicability of municipal ownership of such enterprises. Under the agreement the United Gas Improvement company is to take charge of the works owned by the city immediately on the approval of the ordinance by the mayor, and during the period specified to manufacture and sell gas to consumers at $1 a thousand cubic feet. During the first 10 years of the contract the company is to pay the city all receipts from consumers in excess of 90 cents a thousand cubic feet; during the next five years all in excess of 85 cents; during the succeeding five years all in excess of 80 cents, and thereafter all in excess of 75 cents. It is stipulated that the city may reduce the price to consumers to the extent of its royalties from the company. In other words, if the city desires gas to be sold to consumers at any time in the next 10 years at 90 cents a thousand feet, the consumers get the reduction and the city gets nothing. Another consideration exacted in the agreement is the company's promise to expend $15,000,000 during the term of the contract in the improvement of the works.

Philadelphia's experience with municipal ownership has been discouraging. The city gas-works were erected in 1836, and their management was entrusted to a trusteeship created by an act of Assembly. The trusteeship became in course of years a source of political pestilence. A few years later it was vacated by the provisions of a new charter, under which the city government is now administered, and the gas ring ceased to exist. But the city gas-works seem to have been the victim of more mismanagement, and at the present time the property is practically worthless, in spite of the fact that the plant was valued at $30,000,000 in the mayor's last message.

It is the old, old story of official corruption, incompetence and mismanagement, resulting from political interference.

Proposed Combination of Rubber Wire Manufacturers.

Preliminary steps have been taken in the formation of a combination of rubber wire manufacturers to control the output of the factories which they operate and regulate the price of the product. It is said that the following-named concerns are interested:

Bishop Gutta Percha company, New York.
India Rubber and Gutta Percha Insulating company, New York (Habirshaw).
W. R. Brixey, New York (Kerite).
New York Insulated Wire company, New York (Grimshaw).
Okonite company, New York.
Eastern Electric Cable company, Boston (Clark).

It is reported that the original proposition was to form a company that would dispose of the product of the factories controlled by the companies in the combination and limit the output of each factory to a certain kind of wire. An arrangement for sharing the profits according to the value of the plant and business turned over by the several companies was also proposed.

Coast Signal System.

Announcement is made of a plan that is being perfected by the Navy Department for the establishment of a complete system of signal stations along the Atlantic coast, by which ships of the navy passing near the shore may receive messages from and send them to Washington authorities. It is intended to use, when practicable, the life-saving stations for signal towers, and where such stations are not well located new ones are to be established for the exclusive use of the signal service. A board has been appointed by Secretary Long to report a practicable measure. This board consists of Commander Schouler, Lieut. Gibbons, Lieut. Harlow and Lieut. Anderson of the New York Naval Militia, and has been in session several days. Along the Long Island shore, and at other points where the life-saving service cannot be utilized for the new scheme, stations will be placed in charge of members of the state militia, which will have entire charge of the system in time of war. Communication from one station to another will be had by telephone and telegraph, so that it will be possible for the movements of a fleet sailing well inshore to be kept in touch with the entire system. It is probable that the government will have a special line of wire to Washington, in order that it may be kept in prompt communication with the signal stations, when necessary. For years Great Britain, France and other European powers have used a like system extensively, and with a chain of life-saving stations extending from Maine to Florida it will not be difficult for the navy to apply it here.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the Western Electrician.]

A local telephone exchange is among the probabilities at Preston, Minn.

The long-distance telephone system has reached Blue Earth City, Minn., and will go no further south at present.

St. Croix Falls, Wis., has secured telephone connection with Taylors Falls, Minn.

A commission has been appointed at St. Peter, Minn., to appraise the value of certain lands condemned by the Northwestern Telephone Exchange company.

The Central Wisconsin Telephone company is adding to its list of subscribers at Black River Falls, Wis., materially, and is preparing to have a toll-line to connect with the Winona, Minn., and Arcadia, Wis., systems.

The Perry Telephone company contemplates putting an exchange in Panora, Ia.

The North American Long-distance Telephone company is an applicant for a telephone franchise at Duluth, Minn.

The telephone line to be built from Pierre, S. D., to the Black Hills by Rowe Bros. of Pierre is to be built to Midland this fall.

The Dakota Central Telephone company of Aberdeen, S. D., will rebuild its toll-line to Groton, S. D., this fall.

The Northwestern Engineering company will put in a central exchange for the telephone system at Ortonville, Minn.

Crawfordsville, Ia., wants toll-line connection with Washington, Ia., and offers to build the line halfway if the Washington exchange will do the same.

Menomonie, Wis., is delighted to have toll-line connection with neighboring towns over the Wisconsin Valley Telephone company's lines.

The Wisconsin Telephone company is an applicant for a franchise at Sheboygan Falls, Wis.

The Wisconsin Valley Telephone company has accepted the franchise offered by the Chippewa Falls, Wis., council and given a bond to complete the system in six months.

The Iowa Telephone company has given free service in one or two instances in Des Moines, Ia., to compete with the new Mutual Telephone company. An instrument was put in and the subscriber was to pay $15 per year if he liked it. No contract was asked.

The city of Sheboygan, Wis., may begin a war on the Wisconsin Telephone company by cutting its wires, if they are not removed on 24 hours' notice. The company has attached its wires to the electric light poles.

The Electric Telegraph and Telephone company is an applicant for a franchise for toll-line connection with Superior, Wis.

The merchants of Pierce and St. Croix counties, Wis., are agitating free telephone service to the Twin Cities. The connection to Stillwater, Minn., is very convenient, and that town is getting much of the trade that would go to the Twin Cities if concessions as to telephone service were made.

The Northwestern Telephone company is prosecuting its construction with much diligence to get it completed before winter sets in. The line between Sioux City, Ia., and Yankton, S. D., will be fully equipped in two weeks, and from Sioux City to Canton, S. D., a little later. The work is now done between Mankato and Wells, Minn., and the station at Albert Lea is being equipped so as to give complete connections between Austin and Fairmont. The system is also being extended south from Albert Lea to the state line to meet the Iowa company. The Northwestern company has built and equipped 475 miles of lines throughout the Northwest.

The telephone exchange at Fargo, N. D., is being rebuilt and the whole system improved and enlarged. This is necessitated by the number of subscribers, which has now reached 500. A large amount of new cable will be laid.

New Municipal Lighting Plants for Chicago.

The sum of $150,000 recently appropriated by the City Council of Chicago to extend the electric street-lighting service of the city will be devoted to the erection of two new plants and the extension of one of the old ones. The new plants will be erected at pumping stations of the city waterworks, with the idea that the labor account will be lessened, proportionately, and that the boilers for the pumping engines can be relied upon as the reserve of the electric light stations, effecting a material saving in first cost.

The new South Side plant will be installed in the pumping station at Sixty-eighth street, on the lake shore. It will have sufficient capacity to supply 1,000 all-night arc lamps of 2,000 nominal candle power for the streets in the territory bounded by Thirty-ninth street, Lake Michigan, South Chicago and Western avenue. This portion of the city is now largely dependent upon gas lamps, the service from the city electric lighting plant at Fourteenth street extending only as far south as Thirty-ninth street.

On the North Side a new plant will be put in at Lake View pumping station. It will have a capacity of 600 lamps and will supply the district lying between North and Graceland avennes, the lake and Western avenue, thus meeting at North avenue the street lighting service from the existing plant at Chicago avenue and Sedgwick street.

Specifications for the installations are in course of preparation by City Electrician Ellicott. As has been stated, there will be but one battery of boilers for each station. The engines will either be low-speed Corliss or smaller high-speed units for direct connection to the dynamos, probably the former. The dynamos will undoubtedly be of large size, but in this and other particulars considerable latitude will be allowed the bidders, the object being, of course, to obtain the best plant for the money. Bids will not be sought on each plant as a whole, but on the different parts—boilers, engines, dynamos, lamps, wire, etc.

After the new plants have been provided for, the remainder of the appropriation will be devoted to an extension of the service of the West Side plant at Halsted street and Blue Island avenue.

Street Railway Situation in Terre Haute.

[From the Terre Haute Gazette.]

The Gazette sincerely trusts that the outcome of the trouble into which the electric street car company has been rather precipitately plunged may be a return of his property to President Russell B. Harrison. He has labored with great energy and uncommon ability, early and late, to make the Terre Haute street railway the model system in the country. And he has made it that.

A multitude of difficulties have pressed upon him. Times have been hard. Business has been dull. Failures have occurred all over the country, and here in Terre Haute as well as elsewhere. Taxes have been heavy—the city taxes, county taxes and state taxes, all heavier than they ought to be. He has had a frightful load to carry in the matter of street paving. Vexatious and harassing suits have been brought for damages growing out of accidents. The Legislature has frightened capitalists in the matter of street-car bonds. The council has recently proposed ordinances that would necessitate a large outlay on the one hand and diminish business on the other.

And the result of it all has been that this man, who has worked like a slave and has given us a splendid street-car service, and cheaper light for the streets than the town has ever had and cheaper than most towns have, has fallen down under the heavy burden.

For its part the Gazette is mighty sorry that this has happened. It hopes that he may get upon his feet again and that the road may pass into his hands to be managed by him along the line of progressive improvement inaugurated and carried on by him.

Linemen Cannot Rely Upon Safety of Poles.

There is a general rule of law that it is the duty of employers to use ordinary care to provide for their employes safe places in which to work, and safe appliances with which to perform their work. But the Supreme Court of Errors of Connecticut holds (October, 1897) that this cannot avail injured linemen, in such a case as that of McGorty against the Southern New England Telephone company, brought to recover damages for personal injuries sustained by the fall of a pole. The lineman injured had been sent up a pole, which had been in use about 11 years, to remove the wires and cross-arms. The pole looked well and had been tested by another lineman with satisfactory results. It did not occur to the lineman injured, nor to the one who tested it, nor to the foreman, that there was any danger in climbing it. In answer to the inquiry of the man ordered up this one, if the old poles were all right, the foreman replied: "Yes; we have been up there and taken off old wires a hundred times." But the important point on which it appears to have been decided that there was no negligence on the part of the company, and that, if the accident was the result of negligence, it occurred from the fault of the lineman injured, and that he was entitled to recover only nominal damages, was that it was the custom, rule and practice of the company, and of other companies operating lines of wires on poles, not to place responsibility upon the foreman of a gang for the work of examining the poles to determine whether linemen might safely climb them, but that each lineman was to look out for his own safety in climbing a pole. That this lineman knew this rule, and understood that testing and inspecting were a part of his duties, the court holds, must be presumed from the fact that he was a lineman of 14 years' experience, and in that capacity had formerly been in the employ of the company. As he was able to perform both the work of inspecting and climbing, the court declares the company ought not to be required to employ some other person to test the poles, and that if he chose to rely upon the safe appearance of the pole and the assurances of his fellow workman, rather than to inspect it, and if he doubted its safety to support it by appliances furnished for that purpose, he took the risk of so doing. Nor does the court think that it can be laid down as a proposition of law that the linemen of telegraph and telephone companies have a right to rely upon the soundness and safety of the poles upon which they are working, and that it is the duty of such companies to inspect and test poles, and support such as are insecure, before permitting linemen to climb them.

Electrolysis at Washington.

[From the Washington correspondent of the Western Electrician.]

Inspector Allen of the street lighting department has submitted to the commissioners an important report concerning electrolysis. For some time past he has been engaged upon a series of experiments and investigations. The report gives in detail the line construction of the several railroads using electricity as a motive power, and discusses at length the damages that have resulted to the gas and water pipes therefrom. The inspector states that immediately after the installation of the Potomac company's lighting system from a grounded circuit, the Chesapeake and Potomac company commenced to have trouble with its cables, the resulting damage being so great that the telephone company was compelled to draw into its circuit a bare copper wire, to which it bonded all its cables. The inspector goes on to say "that the solution of the whole matter is very simple. The extension of the underground electric system as is employed upon the Metropolitan railroad lines to the suburban trolley roads is too expensive to be put into operation. But its substitute, the double trolley, can be easily installed and successfully operated." * * * "As long as the rails are used for a portion of the return current, the system will be grounded, and the current, to a greater or less extent, will seek other paths than those provided for it."

Commander Davis of the Washington Naval Observatory has added another chapter to the discussion noted above. In a letter to the commissioners he says: "The observations of magnetic force carried on regularly at this observatory for many years past have been rendered practically useless of late by disturbances caused by the proximity of the Tenleytown electric railway. My attention has been called to a report by Inspector Allen of the street lighting department on electrolysis of water mains. I have been carrying on some observations here with a view to locating the direction and force of local disturbances, and an investigation of the whole subject is now being made." After requesting some information as to the difference in potential between the water mains and the rails of certain electric railroads, he says: "I further understand that it is contemplated to insist on a return wire for electric railways, preventing the grounding of these powerful currents. Should such an intention be carried

into effect it would probably remove the cause of disturbances affecting our instruments, and its results would be directly beneficial to science. The present site of the naval observatory was chosen only about 15 years ago, because it was believed that the location itself and the extent of the grounds were a perpetual guarantee against the disturbances of commerce and traffic. The electric railway had not been perfected, nor could the pernicious effects of its close proximity be foreseen. As these railways are now managed it would probably be necessary to remove our magnetic instruments to a distance of at least two miles before the effects of the local disturbances would cease to be felt. This would retire the observatory from the national capital, which, in view of the amount of money already spent here and the beauty and fitness of the site in all other respects, is not to be thought of. The only other alternative is to discontinue magnetic observations here. This would be a loss to science, because there are only two magnetic observatories on the continent of North America, the other one, situated at Toronto, being unfortunately in the same predicament as ours, owing to the close proximity of a trolley road: so that the accumulation of accurate magnetic observations, which are of incalculable value for the future solution of one of the great problems of nature, has practically ceased in North America."

Power Distribution and the Use of Multiphase Current Transmission for Ordinary Street Railways.

[*Continued from page 275.*]

the feeder end will show a very inky piece of paper, after a run. In practice, on a line which the writer finds it necessary to handle in this way, he gets variations from 450 to 550 volts. The minimum is infrequent, however, and the schedule is made apparently as well as though the potential were absolutely uniform.

Considering the question of abuse of apparatus, the increased voltage is not likely to injure a generator of modern construction. Practically, the only additional care that seems necessary is of the generator fields, noting that the increased current in the shunt windings does not heat them above safe temperature. So long as the potential at the car stays under 600 volts, there is little probability of trouble with equipment. Although the writer has had no such experience, he has known of cases where higher voltages have caused the arcs at controller contacts, when breaking, to jump to the iron frames. This difficulty has been experienced more particularly on small roads using boosters, where one car might constitute the entire load on the booster. At times of throwing off the power the booster holds up its potential for a sufficient time to result in a very greatly increased voltage during the time of the controller opening.

The method just described has the advantage of simplicity and economy. Cases arise, however, when the very great fluctuations in load make its use impracticable. With a line which, at certain times, carries very heavy current, as compared with the average, there must be some means of automatically raising and lowering the voltage at the station end of the feeder, to properly compensate for the variable drops. To accomplish this a booster is used. As has been said, this machine is a series-wound generator, connected in the feeder as it leaves the main bus, and so proportioned that a given current through it will give sufficient field strength to induce an electromotive force in the armature equal to the fall of potential which the same current causes in the feeder. In practice, this condition is only approximated. Were the generator to have a perfectly straight characteristic curve, of proper pitch to match that of the feeder drop, the feeder and potential would exactly coincide with that of the power station. The curves of all dynamos drop away toward the horizontal as the magnets approach saturation. This results in the booster failing to compensate wholly for drops of currents above a certain amount. In practice, however, boosters are used which raise a feeder potential to 1,000 volts, and care for variable loads without allowing the light load voltages to rise at the feeder ends to dangerous amounts. The system has the advantage of caring for extreme overloads on particular feeders, and is useful in cases where, for short periods of time, the feeder load is such as to cause excessive drops, and the time is not great enough to justify increased copper investment. On the other hand, it is expensive of operation, due to the facts that it wastes considerable energy and that it generates this wasted energy in rather an extravagant way. If the booster is engine-driven, the engine has widely fluctuating loads to handle, the load varying as the square of the current in the feeder. These variations necessarily result in a very low economy for the engine. With a motor-driven booster, there are the constant losses of the two machines to meet. These are not so great as those of the engine and booster, but the necessity of keeping a particular generator for use as a booster limits the flexibility of the arrangement as compared with one which permits the use of any of the regular station generators, and, moreover, the addition of a motor booster does not increase the capacity of the station, as the power to drive the motor must come from the engines. The compounding of the standard types of railway generators is usually such that, when full load current is passed through them, the series turns alone will raise the fields to a point that will induce nearly normal electromotive force in the armature. This adapts the machine for use as a booster on almost any line, excepting one requiring more than 100 per cent. increase of potential at times of full load. As lines when so overloaded would be much better provided for by the addition of more copper, they need not be considered. In most cases it is necessary to cut down the electromotive force of the standard generator in order to secure the proper ratio of electromotive force to current for boosting, and this may be done by decreasing either its speed or the number of field turns. The former method has the advantage with an engine-driven unit of improving the engine economy by lessening the friction losses and keeping the cut-off at a less wasteful point, whereas the latter is the simpler way. To accomplish this, the writer uses a long German silver strip of sufficient section to carry the proportion of current that it is desired to shut out of the fields. This strip is fastened to the generator frame, connected across the terminals of the series field and doubled on itself in such a way that a clamp may be slid back or forth on it, raising or lowering its resistance. Knowing the resistance of the feeder upon which the machine is boosting, the clamp may be shifted to the point where the ratio between the readings of the voltmeter and the ammeter is equal to the feeder resistance, and the proper adjustment reached.

For temporary uses, it is possible to make the necessary switchboard connections with flexible cables as the only adjuncts to the apparatus on the regulation board. A cable which may be attached to the positive load of any of the generators at the switchboard and to any feeder answers the entire purpose. With some boards it is only necessary to have terminals on the cable that may be inserted into switch jaws. If the generator leads and the feeders happen to terminate in switch blades instead of jaws, the cable must have its ends fitted to clamp quickly to these blades. With this preparation, in order to transfer a particular feeder to a special generator for the purpose of increasing the voltage upon it, the cable should be attached to the positive generator terminal, the other end hung convenient to the feeder switch, the generator built up already for use, the feeder opened and attached to the cable, and finally the circuit breaker and negative generator switch closed.

If it is desired to extend this system to booster working, it is necessary to have a second cable leading from the positive bus-bar and capable of connection to the negative terminal of the booster. It is best to include a circuit-breaker in this cable to protect the booster, as the regular generator circuit-breaker will be cut out.

At best, however, cables are troublesome appliances and allow only comparatively slow transfers. Moreover, it is impracticable to arrange cables so that two generators may be run in parallel on the special high-voltage service. Where a new board is being installed, and where the circumstances justify the alterations in an existing board, such a one as is shown in Fig 1 (page 275) meets the required conditions. The two equalizing bars make it possible to run two or more machines on each of the regular and high-voltage at one time. With the arrangement any two combination of feeders and generators desired may be had. When running the "special generator" the negative switches are thrown up, and the positive and equalizing switches on the special machines thrown down. The switches on the feeders needing the increased voltage are likewise thrown down. If it is desired to use the auxiliary bus for booster purposes, the equalizing switch is left open and the adjustable field shunt applied, the negative generator switch is thrown down, after closing the booster circuit-breaker, and the feeder is transferred down to the auxiliary bus. This puts the booster generator in series with the particular feeder. One very important thing in this connection is to make sure that the shunt field circuit is open on the boosting generator. It might be advisable to interlock the field switch with the negative generator switch in such a way that the latter could not be thrown down except with the former open.

The drawing of the board shows a wattmeter and an ammeter in each bar. By providing a double-throw switch connected in such a way as to open the lower wattmeter from the feeder board and connect it to the upper bus-bar on the generator side of the ammeter shunt, the four instruments will be in series between the generators, all running on the lower bus, and the feeders all running on the upper bus. This offers convenient means for checking meters, care being taken to see that current passing through the diagonal bar on the back of the instrument panel does not introduce an error into the wattmeter indications.

In a modern station of few large units it is improbable, were the necessity for booster service to exist, that one of the large generators could be spared or would be desirable for the purpose.

In such stations, however, it is usual to install a smaller machine to carry the all-night and other light loads. This machine might be relied upon for the booster work. If the engine driving it have its governor arranged to adjust for a large variety of speeds, both above and below normal, and the unit be designed to run safely at the increased speeds, the combination will be found very convenient for meeting all classes of demand. The speed may be dropped for booster working and rased when the generator is run at high voltage on a particular feeder. With this arrangement of dependence upon an individual unit for the special service, it is, of course, unneccessary to equip the whole switchboard with the extra negative bus. The double positive bus will be found convenient in any station, however.

The three-wire system, although very useful in lighting work, has been of little service in railroad distribution. Its value for the latter purpose has been considerably overestimated, although there are places where its use has resulted in the maintenance of satisfactory potential on sections of track using the same copper, when the usual system could not approach doing it.

The advantage of the three-wire system is based on the fact that it enables the use of double the usual potential for distribution, thus in the perfect case requiring but one-fourth the copper to transmit a given current at a given loss.

This law, that the amount of copper varies inversely as the square of the potential, is due to the fact that doubling the voltage halves the current for a given amount of energy. The same percentage of loss allows a loss of twice the number of volts, and this, with but half the current, admits of the use of copper having four times the resistance, hence one-fourth the weight. The "perfect case" just cited is one in which no third or "neutral" wire is necessary. Such an one does not exist in practice, and this neutral wire has to be supplied to conduct the excess of the current used on one side of the system over that used on the other, between the generators and the motors. In railroad work the rail is used as the neutral conductor. It is seldom that a whole road is operated on the system, the common practice being to apply it to only those parts on which the ordinary system is insufficient. Where there are but one or two sections to operate with the reversed potential, the switchboard described may care for them satisfactorily. If one generator is made to build up with reversed polarity and is coupled into the auxiliary bus, it will handle such feeders as may be thrown upon it as the negative side of a three-wire system. The generator may have its residual charge reversed in a number of ways, one of which is to have the shunt field wired through a double-throw switch on the machine, arranged to disconnect the field coils from the armature and connect them in the reverse direction to a pair of charging wires fed from the switchboard. The machine may have its residual charge brought back to the usual direction by the commonly used means of throwing in the positive and equalizing switches, with the negative open, and allowing the current shunted from the series coils of the other machines to energize its series coil. Where three-pole switches are used on the generators the shunt field double-throw switches may be omitted and the field reversed through the series coil by using an X-shaped pair of contact pieces insulated from each other at the point of intersection. These may be pressed against the switch jaws in such a way as to reverse the current shunted from the other series coils through that of the machine to be reversed. Where the three-wire system is the regular system of operation, and the sections are divided equally between the two sides of the system, a regular three-wire board is preferable. For a less general use of the system, the method described answers as well. The arrangement then becomes the same as that of the special generator, with the polarity reversed, and the potential on the machine may be raised above normal, and the advantage of greater allowable drop in the copper added to that of the saving in track drop, due to the reversed current flow.

The writer has said that the value of the three-wire system in railroad service has been considerably overestimated. This statement probably needs explanation. In lighting work the three-wire system saves 62½ per cent. of the copper. Each wire has to be but one-fourth as large as with the two-wire system, but it is usual to make the neutral of the same size as the other wires, thus requiring three wires, each of one-fourth the size of those of a two-wire system, hence the use in the three-wire system of three-eighths, or 37½ per cent. of the copper necessary in the two-wire system. Because this is true of lighting work, it is often assumed to be true of railway work. It is not, however, and in no case where the track renders any appreciable service as a conductor can the saving from the adoption of the three-wire system approach the above figures. In general, its use will make a gross saving of the loss in track (assuming that there is no copper paralleling the track that may be used as a positive feeder). The net saving will be this gross loss in track less the track losses due to the passage of current from car to car, and of the excess of current due to lack of balance, back to the power station, and the increase overhead loss due to the greater drops in the divided feeders than in them when combined. The sketch (Fig. 2) may present this more intelligently. It illustrates the simple case of an unbalanced three-wire system, and shows that its losses aggregate 4,100 watts under the particular load. If this system were changed to a two-wire one by throwing the feeders in parallel it would

save 400 watts in the feeders and lose 800 more in the track, leaving a net loss of 400 watts, or about 10 per cent. of the total loss. Such a difference as is shown by this hypothetical case would not justify the complication introduced by the system. The only conditions where the method seems to be applicable are those of excessive track losses with fair opportunities for balanced load. Such a case existed on the Lowell and Suburban road. They have a heavy business over a double-track line to their park, some six miles from the power station. By changing to positive feeders those formerly used as overhead returns, and operating the line as a three-wire one, they very greatly improved the efficiency of the distribution system.

In the selection, from the various systems of distribution, of the one best adapted to a particular instance, there is always a large number of variable factors to consider, and usually more or less speculation as to the value of certain ones on which no accurate data are accessible. This makes it impossible to work from fixed laws, and demands individual consideration of each case. For these reasons, there is considerable room for divergence of opinions in the matter. The writer has given his ideas as to the comparative infrequency of cases in which the three-wire system is desirable. The booster has a very much more general application, and is suited to a greater number of cases than is any one of the other systems. Nevertheless, wherever work can be satisfactorily handled by a special generator, it should be, unless the change involves abandoning existing apparatus. The last method saves considerably over the booster, and is preferable for its simplicity. The only limiting condition to its use is satisfactory regulation.

The alternating current system, with rotary converter sub-stations, competes with the booster and special generator in cases where the load factor (the ratio of average to maximum load) is high, and where the regular 500 volt transmission will suffice during only a few of the 24 hours. In such a case the copper losses, because of the length of time during which they are excessive, are so great that they may often exceed the entire expense of an alternating transmission system. The latter system also enters into competition with the independent power station for that class of business that is too remote from an existing station to admit of satisfactory handling by the other transmission methods and too small to furnish load for such a station as may approach in economy the station from which the alternating transmission would be operated. Cases of each kind arise with city roads, in their needs for transmission to suburban centers of load, and with interurban roads.

The roads which the city station receives from the suburban centers have usually a very low factor. At morning and night they are excessive, and through the remaining hours comparatively light. Were an alternating transmission system installed for such use it would probably lie idle for a large part of the time, its copper being used to transmit direct current. During the heavy hours it would be called into service. This same service might be rendered by raising the voltage on the different current feeders by use of the "special generators," and allowing the loss, which has been from five per cent. to 10 per cent. during the light load, to become 25 per cent. or 30 per cent. In this way the line may carry three or four times as much current and maintain the voltage at the distant end.

In comparing the systems, it is necessary to compute the annual cost of each, including the items in the following list:

Alternating Current.	Direct Current.
Fixed charges and repairs on main station static transformers, if any, and on sub-station static and rotary transformers, and accessories.	Interest, depreciation and repairs on such increased cost of engines and generators as is occasioned by their being fitted to furnish increased voltage.
Fixed charges on sub-station land and buildings.	Cost of fuel to produce output representing difference between losses in direct current feeders and those in alternating current feeders and transformers.
Sub-station labor.	

This assumes that the same amount of copper is used in each system, that the alternating system does not remove the need for sufficient copper to handle the load with direct current during a part of the time, and that this amount of copper will suffice for heavy loads by means of the increased direct current potential transmission. Should the load be of such a nature that the alternating transmission would be operated throughout the whole time, there may be a correction made in its favor of the annual cost on the increased amount of copper necessary for the direct current system over that for the alternating system. It is probable that the direct current generator and engines need not be increased in cost more than 10 per cent. by the requirements of the increased voltage. The writer has said that he is operating satisfactorily with machines designed for the standard voltage. Points which should be made against the alternating current system, which cannot be given exact money values, are the danger to life from the increased voltage, lack of uniformity in equipment, making lack of flexibility in stations (where, under the other arrangement, any generator may serve any demand) and the danger of delays due to the increased complication of the system, it sometimes requiring 15 or 20 minutes to start the sub-station machinery and get it into service after it has been stopped in the midst of load by accident. These points of disadvantage are very important ones, and operating companies can well afford to expend considerable money to avoid them. Especially is it undesirable to install for railroad work a system which may be disturbed by the extreme overloads such work introduces, and which cannot be restored to an operative condition immediately the load is brought within bounds. With the rotary transformer system any short-circuit or extreme load, which is not relieved by the sub-station direct current circuit-breakers, may stop the rotaries and shut the power off the line during the long interval it takes to start them and put them into service.

In the comparative estimate, the results depend more upon the load factor than any other condition. With it sufficiently high, the alternating transmission may show an economy over the direct current for areas within a very few miles of the power station. Unfortunately, however, the yearly load factor is usually very low on railroad work. With such a condition, it is cheaper to have excessive losses in copper at times of heavy loads than to carry the necessary equipment of alternating transmission apparatus to keep the losses down at such times. The railroad manager naturally insists that the voltage be maintained reasonably near its normal value over the whole road at times of heaviest business. Estimates that show immense costs for copper to accomplish this under the regular distribution system make him turn to the consideration of additional power stations and multiphase transmissions. If he can be shown that he may care for his maximum loads over the existing copper by simply raising the voltage on the station end of the sections of heavy loss, and pay for the loss with coal instead of with interest and depreciation on a great amount of additional machinery, he is likely at least to determine carefully which he can better afford to do.

While, in the writer's opinion, the majority of cases may be best handled by direct current distribution, there are many instances of need for a distribution system where none but the alternating current system is applicable. Where water powers are used, they are almost always so remote from the center of load that very high potentials must be used for economical transmission. Long interurban roads operating so few cars that load can be had for only one power station bring a condition where distribution must be accomplished by sub-stations, on the alternating system. The Lowell transmission presents a case where it was a problem whether to care for the new territory with a separate station, or to transmit it from the existing station. So much has been written about the multiphase current system that was decided upon and installed there, that it is unnecessary to attempt a description of it. Mr. Sullivan, the general manager of the company, has kindly furnished the writer with a copy of the estimates from which the choice of systems was made. He states that operation justifies the estimate in its statement of the cost of the multiphase system. It showed the cost of power delivered to the trolley wire to be for the transmission system 70 per cent. of that for the separate power station. There were no figures showing what this work could have been done for with a booster system. Inasmuch as the latter method has been used successfully in place of the other, temporarily, it would be interesting to know its comparative cost. Tests of the Lowell system, extending over 18 days, showed an all-time efficiency of 70 per cent., as measured from alternating generator output to rotary converter output, the losses being those of two sets of static transformers, line and rotaries. The maximum efficiency for any one day was 73 per cent. The voltage regulation at the sub-station is about equal to that of a well governed steam-driven power station.

The writer has said that the use of alternating currents for ordinary electric railways is limited to the rotary converter system. This is due to the fact that alternating current motors, in their present state of development, are not adapted to the needs of such railways. As yet, their use for traction purposes is limited to a few European roads, of which the best known is in Lugano, Italy. Alternating motors have the disadvantages of limited torque and tendency to synchronism. This makes them poorly adapted for the uses of any line but one having long runs at practically uniform speeds and few stops. These conditions are those of a through express service between cities. Accommodation and ordinary street railway services are such as can only be handled satisfactorily by direct current motors. At first notice, this fact seems rather contradictory to one's ideas of the flexibility of alternating currents. The ideal system has been thought to be one composed of a generating station containing large multiphase generators, with lines distributing current at a potential high enough to require but a comparatively small amount of copper, static step-down transformers, and motors that may be regulated throughout all desired variations of speed by merely changing the impressed electromotive force with a controller depending upon the use of various ratios of transformation. This dream included the freedom from the care of commutators, and pictured a car equipment that would need a minimum of attention. Were it possible to realize all those advantages, it is probable that the somewhat serious complication introduced by the necessity for two trolley wires might be tolerated. There seems to be little probability, however, of an early solution of the problem of adapting the alternating motor to the intermittent work of the street railway.

In conclusion, the writer desires to say that the title of this paper may have led some to expect rather more particular attention to the multiphase transmission system, and less about direct distribution. He has, however, given the various systems the same relative importance in the paper that he considers them to have in application. Hence, the subordination of the alternating current system in the consideration of the general subject of "Power Distribution."

LOSSES IN WATTS.

	TWO-WIRE SYSTEM.	THREE-WIRE SYSTEM.	SAVING.
+Feeder	$60^2\times1=3600$	$20^2\times2=800$	-400
− "		$40^2\times2=3200$	
Track	$60^2\times\frac{1}{4}=900$	$20^2\times\frac{1}{4}=100$	800
Total	4500	4100	400

Development of Electric Cableways.[1]

By Richard Lamb.

Large expenditures of thought and money have been made to devise means of transportation that can disregard the insurmountable difficulties of some surface roads, such as excessive grades, too much bridging, or too great a cost for roadway. The natural suggestion has been to make the roadway through the air, and air-ships, flying machines and suspended cableways have been sought for to solve the problem.

Macaulay wrote, "Of all inventions, the alphabet and printing press excepted, those inventions which abridge distance have done most for civilization."

The most baffling problems we have before us to-day are those of abridging distances. With all the expenditure of life and money that has been put into the endeavor, man has not as yet even been able to traverse this orb of the universe upon which we are living, and with untold riches as the goal, thousands stop within a few hundred miles of the Klondike, at the first short pass, to await a less hazardous season to risk the journey.

There are millions of feet of valuable timber in swamps standing within rifle-shot distance of convenient points of navigation that have been practically unobtainable. The miry soil makes regular roadbeds too expensive, and it has been as impossible to get the teams into the swamps as to get the logs out. It was to solve this particular problem of abridging distances that my electric cableway was built.

I first built a cableway, having portable iron bracket supports to attach to the trees, and an endless cable supported by sheaves upon the brackets. The cable was passed around a sheave which was driven by a steam engine at one end of the line. This cableway worked well, and could haul logs for a distance of half a mile, which was farther than the distance attained by any other method previously tried. I found that steam cableways were limited to straight lines, and as trees do not always grow in long straight lines, I devised a means by which the car would replace the traction cable in its sheave if it was dislodged in passing a bracket on account of the cable line not being straight. But this did not obviate the difficulty of having to select the route with reference to a straight line.

In the excellent article on "Railways in the Air," published in a recent number of the Strand, the writer states: "Two stout wire-carrying ropes are laid parallel on standards of wood or iron and then stretched tightly in a straight line. Aerial ropeways cannot run around corners." This condition is due to the fact that a moving cable has a tendency to work itself out of its carrying sheave, unless the line of the pull of the cable is straight. This fact suggested to me the necessity of the traction cable being stationary. It was a natural advance in the line of thought to note that if a sheave would transmit sufficient power to haul logs a distance of half a mile from the same, that it would be even more efficient if the power applied to the sheave was near by and accompanied the load on its travel. As an electrician, the cables of the steam rig naturally suggested to me conductors for an electric motor that would operate the sheave. Such a motor admits of the traction cable being stationary by passing it about the sheaves several times and anchoring it at both ends; thus, the motor winds in and pays out the cable, on the principle of a capstan. The fact that the traction cable is stationary, and that the lower bracket catches the cable as the motor passes, makes a system of this kind the only one that can be operated upon concave and convex curved lines.

One of the essential features of the steam cableway is having the traction rope always parallel with the bearing cable. The disregard of the direction of forces in other cable systems has been one of the main causes of their failure. On approaching a support the cable naturally sags and the carriage

1. Read before the American Institute of Electrical Engineers, New York, October 27, 1897.

has to be propelled up an incline. If the grade of the cable is steep, as it is in practice, and the power is applied in a horizontal direction, the resultant force will neutralize the pull, and the carriage will stop. Cableways, operated by horses upon the ground, pulling the carriage on the cable, have accordingly been inoperative. It was important, therefore, in the electric cableway, to have the traction cable always parallel with the bearing cable. Supposing the incline of the cable is raised until it is vertical, we would then have an elevator; the bearing cable being the guide and the traction rope the hauling rope, the motor being on the elevator car instead of at the top or bottom of the shaft. It is this feature that enables this system to operate on grades that would be impracticable by other methods.

This system consists of a carriage with grooved wheels in tandem that move upon a cable or suspended trackway. From this carriage is hung a frame, pivoted to the carriage so that it can maintain a vertical position regardless of the grade of the track. This frame holds an electric motor, preferably of an iron-clad cylindrical type. The motor is geared to an elliptically grooved sheave. A steel cable is wrapped around this sheave two or more times and is anchored at both ends. For the sake of economy in conductors, the upper or bearing cable is insulated from the lower or traction cable and is used to carry the electric current. The carriage is insulated from the suspended frame and motor. An insulated wire is attached to the carriage and conveys the current to the rheostat. The other pole of the rheostat is connected with a convenient part of the suspended frame. The rheostat is designed to control the speed and reverse the current. A circuit-breaker is put in circuit. Tracing the current from the generator, it passes along the bearing cable to the carriage, thence through the insulated wire, through the rheostat to the frame of the motor, thence through the traction cable, back to the generator. At intervals along the line, connection is made between the traction cable and the ground. A bar of copper-coated iron is buried at the foot of a tree or post to which the cable brackets are attached. A well bonded copper wire extends from this ground plate to the lower bracket, upon which the traction cable rests. In swamp and canal service the plate is buried well into the moist earth. A most marked difference in the resistance is noted when the ground connections are disconnected. When connected, the resistance is the same as if the traction cable was the same size as the bearing cable.

In making the first saddles to support the cable they were designed for movable brackets, which could be easily put upon trees and removed to other trees when the line was changed to a different location. These saddles have a U-shaped clamp that goes over the cable and is bolted down with wedge-shaped bolts. Under the saddle is a petticoated recess, designed to shed rain-water from the insulation placed between the saddle and the bracket to keep the current from grounding or short-circuiting.

This develops a new feature in insulation. It appeared that many of the materials ordinarily serviceable for insulating were not available, owing to the fact that often a rolling load of 10,000 pounds or more passed over the brackets, producing a grinding and crushing effect.

Lava, hard rubber, micanite, shellac, mica and its products, glass, porcelain, ozite and all products of rosin, proved to be too brittle. Vulcanized fiber was finally used and proved quite satisfactory for a time. As only 220 volts are used in logging plants, and as it is an advantage from a construction standpoint to have the insulation as thin as possible, sheets of fiber one-eighth inch thick were used. It was found that although this insulation was protected from the rain by being shellacked and covered by a petticoat, after being exposed for some time it would lose considerable of its resistance, and while some of the brackets could be passed by the electric motor, the heavy load on others would cause a short-circuit through the insulation. This was averted by painting the saddles, brackets and fiber with insulating paint, and by increasing the thickness of the insulation to one-fourth inch and using fiber that has been solidified under unusual pressure. This was found to work all right.

The saddles for the plant for the Erie Canal towing test were made so that the tread of the bearing wheels would leave the rope, and the wheels would pass over the saddles on their rims, guided by flanges cast upon the saddles. On curves these flanges were made concave or convex as required. These saddles worked excellently, and the motor passed over them easily and satisfactorily. These brackets were insulated with ozite and vulcanized fiber and painted with insulating paint.

Work in swamp logging demonstrated that small short saddles are all that are needed, even for deflections in the line of from 20 to 25 degrees. The saddle was much simplified by attaching to the brackets an insulated cone-shaped pin, over which the saddle is placed, by having a cone-shaped recess in the under part of the needle to fit the pin. This recess also acts as a petticoat to protect the insulation. The question of insulating the cone-shaped pin was an important one. Vulcanized fiber could not be molded upon the pin. A material was needed that, while having a high resistance, would adhere to the pin, and that would stand a great crushing strain. It should be preferably non-hygroscopic and show a minimum absorption of water.

Insulated trolley hangers were secured, that showed an insulation resistance measured under 150 pounds vertical stress above 300,000 megohms, and after sprinkling with water, one-half hour, measuring immediately above 300,000 megohms; after again sprinkling with water 20 minutes, they measured immediately above 300,000 megohms. Tested for absorption after soaking in the water four days, they showed weight of 312.9 grammes; weight as received 312.7 grammes; absorbed 0.2 gramme.

In the insulated stud made for the saddles, the breaking strain measured over 35,000 pounds. At that point the insulation showed no signs of giving way, and the same stud was subsequently used for regular work. The instrument used for measuring the crushing strain measured only 50,000 pounds. It was thought best not to test above 35,000 pounds, which was more than needed in any service it would be required to perform. The pressure was put upon the top of the saddle and the bottom of the stud. As the thickness of the insulation is over twice as great on these saddle pins as was used on the trolley studs tested, the resistance should be at least over twice as great.

The best steel cable for cableways are the interlocked and patent locked wire rope. These are almost as compact as solid bars of steel, and yet can be easily coiled by hand in coils four feet in diameter. A simple coupling is used to connect the cables. The wheels of the car pass over these couplings so smoothly that the rider on the motor scarcely notices the fact. These points of connection are as strong as any section of the cable. An advantage in these interlocked cables is that they present a smooth surface of comparatively flat steel, which wears a great many times longer than the ordinary cables whose surfaces present round wires that wear through and unravel. These cables are made to bear much greater strains than the ordinary cables, and being so nearly solid they make much better electrical conductors.

The traction cable is made of five-eighths inch or three-fourths inch specially strong "19 wire" steel rope, with a soft iron wire core, in place of hemp, which is ordinarily used. This increases the conductivity. One of the most remarkable results in practice in this system is the fact that the traction cable does not have to be pulled very taut; in fact a sag in the cable seems to be of no disadvantage, as the motor does not tighten the line far ahead, even when doing considerable service. The sag adds to the weight of the cable and to the friction on the brackets, and these two resistances act as an anchor for the traction cable, independent of the terminal anchorages. For example, in the case of a trial plant for a German canal, the resistance to be overcome by a motor, or its "draw-bar pull," was to be 645 pounds. Now, at one pound per running foot of traction cable, the influence of the motor pull would only be felt 645 feet ahead of the motor. Therefore with motors distributed 645 feet apart, each one practically has its traction cable anchored from the motor ahead, and, in consequence the combined pull of all the motors is not exerted upon the terminal anchorage.

In the first plant, the clamps on each of the lower or traction cable brackets were made with steel jaws, with springs under them, such as are used on grip-pulleys. When the traction cable was pulled the clamps gripped the cable, and when the motor lifted the cable, on pasing the bracket, the jaws released the cable. These clamps were found to be unnecessary.

In canal practice the terminals will be 10 miles apart with tension stations every two miles. At the terminal stations rotary transformers will transform the high-voltage alternating current to 500 volt direct current, and send the same each way a distance of five miles. When the traffic justifies, a line will be placed on each side of the cable, when the insulated or bearing cables will be connected at intervals to feed each other. The anchorage of the traction cable will be made with a series of clamps, and the motors will be passed through them as canal boats pass through locks. At the end, the motor is released from its traction cable and is conveyed across the canal on a cable, or where masts are allowed on boats in the canal, by a hinged trussed track that can be opened like a gate, or raised out of the way. The handle of the rheosat is easily controlled from the boat by a cord attached to the handle. When the cord is pulled from the opposite direction to which the motor is to be run, the current is admitted in the proper direction, and the motor proceeds. When the cord is released, the handle flies back to a vertical or cut-off position, and the motor stops. When two boats pass they exchange motors by simply exchanging tow-lines and controller cords.

The first test of canal-boat towing with this system was made on the Delaware and Raritan Canal at the Trenton Iron Works. The motor was made to go over concave and convex curves and up and down grades while towing the boat.

In reference to the test of canal-boat towing on the Erie Canal, at Tonawanda, it is not necessary to make any apologies for the system. Superintendent of Public Works Aldridge, in his report to the Legislature, unqualifiedly indorsed the system and stated: "Early in the spring of 1895 application was made to me to officially designate a part of the Erie Canal for the proposed test of the efficiency, economy and practicability of the so-called 'Lamb system' for improving the present system of towage on the canals of the state. The location selected was a piece of canal about 1¼ miles in length at Tonawanda, N. Y. The purpose was to select such a portion of canal as would embrace as many practical obstacles to the success of such a plan of towing as could be found anywhere in a section of canal that length."

In the report of Charles R. Barnes, electrical expert for the Public Works Department of the state of New York, he sums up by saying: "The electric towing system appears to present so many meritorious features that I have no hesitation in indorsing it as the system deserving preference over any other hitherto experimented upon, or likely to be devised in the near future."

So short a time was given in which to construct the trial plant that existing models had to be copied. The motor was over nine feet in length; it weighed 2,213 pounds. The elliptically grooved sheave was driven by a worm-gear. The voltage, which was gotten from a trolley line, fluctuated from nothing to 500 volts, but seldom equaled the latter amount. The bridges under which the motor had to go were very low, and had to be approached by reverse curves on a grade of about 20 degrees. Trenches had to be dug next to the abutments to give room for the motor to pass under the bridges. Both convex and concave curves had to be passed over, and at one point the deflection was about 30 degrees. In spite of the difficulties the trial showed that the system performed economically and efficiently all that it was designed to accomplish.

In the plant recently constructed for trial on a German canal, the motor has been shortened to less than five feet in length, and its weight reduced to 1,300 pounds. The worm-gear has been avoided by a double reduction direct gear, gaining 50 per cent. in efficiency over the worm-gear, and the elliptically grooved sheave has been placed about the cylindrical electric motor, getting a large bearing surface and increasing the efficiency accordingly. At the test made at the Trenton Iron Works this motor, using a five horse power Storey motor, wound for 500 volts, and going at the rate of 2.3 miles per hour, pulled 800 pounds when having the use of only 220 volts. This shows a remarkable efficiency, which is due to the mechanical principles utilized, viz., hauling the motor along by a fixed rope, attached to a capstan operated by practically a winch.

The uses to which this method of telpherage can be put are so numerous that I will not attempt to give descriptions of plans that have been and are now being made for such services as fortification work, rice culture, mining plants, ship building and sewer excavating plants. I will confine my descriptions to completed work.

Possibly the most universally serviceable application that has been made of the system is traversing motors with double hoisting drums for quarry purposes. These motors are to go on 700 feet span cableways. Each of these cableways has one end stationary and the other is movable on a curved track. It is designed to lift 10,500 pound rocks at the rate of 100 feet per minute and traverse at the rate of 600 feet per minute. At a test at Trenton made upon a temporarily erected cableway we raised 6,600 pounds, and ran on the cabe at the rate of 10 miles per hour, part of the time going up a grade of over 30 degrees. There will be no difficulty in these motors raising over 10,500 pounds and running 10 miles an hour. A 15 horse power Storey motor is used. The rheostat reverses the motor and regulates the speed. A band brake also is used to regulate the stopping. This is controlled by a lever in front of the motorman. There is a safety brake to be used in case the band brake should fail. This is operated by a wheel. The shoe of this brake clamps the upper cable. It is attached to the car proper, and with the wheel handle oscillates with the carriage as it climbs or descends grades. A lever in front of the motorman is used to control the speed of the drums that raise and lower the skip. A friction clutch, controlled by a wheel handle, disconnects the traversing sheave gear and engages the hoisting drums or vice versa.

In a place within reasonable distance of an electric plant having surplus power, these electric cable hoists can be erected and operated for a comparatively small cost. In contracting work, where electric lights are also used, these cable cranes can be used to great advantage. In other places the small generating plant necessary to operate these motors will add but little to the expense of an outfit.

Those who think that electrical machinery is of such a delicate nature that it is only serviceable for cities of advanced civilization should go to the Dismal Swamp, and see a so-called dainty machine doing as rough and dirty work as any service to which a machine could be put. He would see the laborers, over their knees in mud, sawing down giant trees, and hear the woodsman sing: "Stand from under; she's saying good-by to her neighbors." With a crash that throws mud and water high into the air, a tree will fall and fill a space with broken limbs, embedding itself well into the mire. This means work for the motor. Logs are to be drawn from their beds, and when the ammeter in the generator room on the scow, for an instant runs up, possibly to a point of overload, it is the motor overcoming the suction in drawing out a buried log. With the voltmeter standing at 220

volts, you would see the needle momentarily go to 35 amperes and then drop to about from 10 to 16, depending upon the size of the log. As the cone over the end of the log strikes a stump or a cypress knee, the needle flies to about 20 and then back, and as the log dives off an obstruction it may be crossing, the current drops to zero momentarily. Finally when the log reaches the tail-tree about 20 amperes is recorded as the log rises from the ground and hangs suspended by the hauling cable. This cable is rived through a sheave, which is attached to the tail-tree 50 or more feet from the ground.

After a number of logs are drawn to the tail-tree, they are transported over the cableway to the terminal on the banks of the canal. Reaching the ammeter as the log comes in, we see it start at about five then go up to 12 or 14, as it crosses the bracket saddles, then go down to five again. In this process of transportation, one end of the log is suspended by a car on the cable. The end of the log is raised from the ground by holding fast the hight of the grip-block rope and going ahead with the motor. The block is attached to the car, when the same results are produced as if the power was applied to the rope direct. When the end of the log has been raised to the proper elevation, the grip holds it from falling, and the rope is coiled and placed on the tongs which holds the log, and after getting a couple of cars loaded you are ready to carry your valuable logs from one of nature's worst fastnesses to a point where they become valuable to mankind.

The question has been asked: "Do you require expert help about these logging plants?" In answer, I would say that I am satisfied with my superintendent. He has spent his life in swamp logging, and has had no chance for education, much less scientific studies. When I assembled the generator, the first time that I put up the plant, he put on a pair of rubber gloves, not wishing to run any chances of getting a shock, even if there was no fire in the boiler. While testing the plant a fuse blew out on the generator, and one of my negro helpers started on a run in the swamp and never returned again to work.

In spite of the lack of electrical information of the logging crew, no inconvenience has been occasioned on that account. All features of insulation are provided for before the plants are shipped. An ordinary steam engineer acquires quickly the necessary information for running the dynamo. The motor is shipped with all parts adjusted, and the extent of the motorman's duties is simply to push the handle of the rheostat according to the direction he wishes to go.

The light first cost, the high efficiency, the ease with which it can be operated by ordinary mechanics, portend for this system an important place among the useful applications of electricity of this century.

New Keystone Instruments.

The Keystone Electrical Instrument company of Philadelphia announces a new line of switchboard, potential and current indicators, designed to meet the class of trade requiring accurate and durable instruments at low prices. The cut shown herewith gives a general idea of the shape of the instrument and the character of the scale. The instruments are

NEW KEYSTONE INSTRUMENTS.

mounted in a tastefully designed case, finished in oxidized copper and well lacquered. The moving parts are mounted in jeweled bearings, the cases are dust-proof, and the instruments are not affected by external magnetism or changes of temperature. While the prices at which these instruments will be offered are low, yet it is claimed that none of the essential features of a thoroughly reliable instrument have been in any way slighted.

At Knoxville, Tenn., on November 6th, the Supreme Court of the state affirmed the decision of the lower court in the consolidated causes, involving rights of way on principal streets for street railroad purposes. The opinion was in favor of the Knoxville Street Railway company, of which J. Simpson Africa of Philadelphia is trustee, and against the Citizens' Railway company, of which W. G. McAdoo of New York is president.

Development of Hydraulic Power.

The influence which the introduction of electric transmission has exercised upon the development of hitherto unused water powers has been noted repeatedly, but its growing importance is made apparent by the frequent references to new plants and applications. This is true in various countries, and in La Revue Technique for August 25th and in the Zeitschrift des Vereinigten Deutscher Ingenieure for August 14th the subject is brought out by reference to new or contemplated installations.

In the former journal M. Durandy calls attention to the resources of the Alpine departments of France. In the departments of Savoie, Haute-Savoie, and Isère, the power of the mountain streams has been utilized to a large extent already, and a company has now been formed to develop the water power of the Maritime Alps in a systematic manner.

Of the sites controlled by the company there are three of especial importance, namely, the fall of Mesela, the fall of the Plan du Var and the fall of Cians. The first two of these utilize the water of the Var, furnishing about 700 cubic feet per second, with a fall of about 38 feet in the first case and 70 feet in the second.

Taking into account the various losses, it is estimated that these two plants will develop 2,000 and 4,000 horse power respectively, but the construction of the plants will involve some tunneling in order to take advantage of the sudden curves of the stream through its rocky channel, and obtain the necessary fall within a short length.

The third site is one of reverse conditions, the fall being great and the volume small. By the construction of a short canal a fall of 400 meters, or about 1,300 feet, can readily be obtained, but the volume of water available is only about 28 cubic feet per second, from which, however, at such a head, an effective development of 3,200 horse power can be obtained.

None of these installations is as yet constructed, but the first is now under way and is expected to be completed within a year, while the others will follow as the demand for power warrants. It is expected that these new developments of hydraulic power will be of increasing importance, because of the neighborhood to the Mediterranean ports, thus bringing manufacturing and water transportation in close proximity.

The article in the Zeitschrift des Vereinigten Deutscher Ingenieure is by the well-known electrician, Herr Uppenborn, and describes some of the new hydraulic and electric plants already completed and in operation in various parts of Germany and Switzerland.

Among these may be mentioned the power plant at Hollriegelsgreuth, on the Iser above Munich, where a volume of about 2,000 cubic feet per second is given a fall of nearly 10 feet by a dam, more than 2,000 horse power being developed for electric lighting and power in Munich.

In Switzerland, the hydraulic plant at La Goule, in the Bernese Jura, is of interest from the fact that the water of the Doubs is conducted through a tunnel, and then through a closed pipe 7 feet 4½ inches in diameter, giving an effective head of 82 feet capable of developing about 4,000 horse power, although the turbines as yet in use give only 2,000 horse power. Current is furnished from this station, both for lighting and power. Some data are given as to charges, which would be more valuable if they were more comprehensive. For motors of two to 12 horse power the price is about $50 per horse power per year, but special terms are made for larger powers. Current is distributed within a radius of 10 to 15 miles, the loss in transmission averaging about 10 per cent. for lighting and 20 per cent. for power.

Another recent Swiss power plant is that at Zufikon-Bremgarten, where the power of the Reuss is utilized by taking advantage of the fact that the river makes a bend of nearly 180 degrees, and that there is a difference in level of nearly 18 feet between two points in the stream which are thus brought so near to each other that a short canal through the intervening neck of land enables the water to be brought across. A canal less than a quarter of a mile long thus permits the utilization of about 1,300 horse power, of which nearly 800 horse power is distributed in small motors at Zurich; 240 horse power is used in the large flouring mills of that city, and the rest is used for lighting purposes.

Dr. H. Bendelack Hewetson of Leeds, England, writing of the danger of temporary blindness due to exposure to strong electric light, says: "It is found by experience in Sheffield that ruby glass shields or spectacles of such a density as to reduce the full light of the sun's disk to the intensity of a single candle power are required to preserve the workmen's eyes from the effects of large electric welding operations. In view of the ever-increasing application of electricity for welding, boring and like engineering operations, the reports of such symptoms (which agree in all details with those which I had some time ago the opportunity of observing and reporting) are of the greatest interest and importance, as pointing to the best means for their prevention, and, when they unfortunately do occur, their cure."

CORRESPONDENCE.

New York Notes.

New York, November 9.—Another chapter in the long history of the agitation for rapid transit in this city was closed yesterday, when the Supreme Court commissioners reported that the road, as now planned by the Board of Rapid Transit Commissioners, ought to be constructed and operated. The court commissioners approve of the engineering plans of the Rapid Transit Board in every detail and are satisfied that the cost will not exceed $35,000,000 at farthest, while $30,000,000 is a fair estimate. Electrical men will observe with satisfaction that the tunnel scheme is heartily commended. "Our own observation," say the court commissioners, "no less than the testimony submitted herewith, has convinced us that no adequate solution of the rapid-transit problem in this city below the Harlem is practicable except by an underground road. The criticisms generally made upon tunnels are not applicable to the tunnels contemplated in this plan. Experience in other cities, including our personal examination of the Boston subway, has convinced us that, where the motive power involves no combustion and where suitable light without combustion is provided, travel in tunnels can be made thoroughly wholesome and agreeable. Even if it were to be less so, it is not too much to say that the construction of high-speed railroads to occupy the surface of the streets of New York is open to grave objection." The proposed railroad will have capacity to carry at least 425,000 passengers a day, and the court commissioners are satisfied that it will carry at least 300,000 a day from the start. The figures of construction and operation are interesting: "Considering the statistics furnished by the Elevated Railroad company and having due regard to the expense incident to motive power, involving, as in the case of electricity, no combustion in the tunnel, the operating expenses of the road will not, in our opinion, exceed 60 per cent. of the gross receipts. On the basis of 300,000 passengers per day the gross annual receipts from passengers would be $5,475,000. Adding estimated receipts from advertising, etc., $100,000, the gross receipts would be $5,575,000. Deducting operating expenses, 60 per cent.—that is, $3,285,000—the net earnings would be $2,290,000. Interest at the rate of 3¼ per cent on an amount not exceeding $35,000,000 would not exceed $1,137,500. Estimating cost of equipment at $7,845,000 and allowing 10 per cent.—that is, $784,500—for interest and depreciation, which we consider a liberal allowance, this will mean a total of $1,922,000, leaving a balance of $368,000." This balance is more than sufficient to meet sinking fund requirements.

The State Railroad Commission has approved the application of the Dry Dock, East Broadway and Battery Railroad company for permission to change the motive power on its road from horses to the underground electric trolley system, conditional upon the company filing with the commission affidavits showing that the consents of the owners of one-half in value of the property on the streets traversed by the road have been obtained in favor of such change. Pending the filing of such consents, the company is authorized by the commission to install the necessary underground work at the crossings of other street surface railroads which are now adopting a similar system of motor power, so that all work at such points may be done at once without necessitating the tearing up of the pavements again.

Twelve of the new electric cars of the Metropolitan Street Railway company were placed in service last week between Astor place and Forty-second street, on that part of the Fourth avenue and Madison avenue line which has been completed. The operation of these cars marked the opening of the company's new conduit trolley system, with which not only the Madison avenue road but Second and Eighth avenues and several crosstown routes are to be equipped. At present the energies of the company are being devoted to finishing the Madison avenue line. Men are working night and day in hastening the work, and it is expected that in less than a month the whole of the road, from the postoffice to Harlem, will be available for transit purposes. By those who traveled in the new cars the system was pronounced an unqualified success and a decided improvement upon the means of transport hitherto employed south of Lenox avenue. The new cars are built on exactly similar lines to those used on the cable roads. They are illuminated at night by eight incandescent lights, while the front and back platforms are also well lighted. The motormen in charge were experienced men drawn from the Lenox avenue system, who were engaged at the same time in "breaking in" the new hands who will be required when the service is extended.

M. S.

From Old Virginia.

Richmond, November 8.—The Richmond council committee on streets, after four hours' discussion, agreed by unanimous vote to report favorably the ordinance granting the Virginia Electric company of Baltimore permission to develop the water power of the James River and to furnish electric lights and power. Many prominent business men appeared in support of the measure, which has attracted a great deal of attention here. An unsuccesful attempt was

made to require the company to put its wires in conduits from the start. The enterprise will involve $1,500,000, and is to be under way in a year.

Judge Norton of Alexandria has granted a charter to the Washington Electric and Manufacturing company.

The probabilities are that the general offices of the Richmond Railway and Electric company will be removed at no very distant day from its present location at Johnson's Island and installed in a handsome building, which will be erected at the northeast corner of Seventh and Franklin streets. Some time ago Mr. George E. Fisher, general manager of the company, sought to purchase this property, saying that he wanted the general offices of the company to be located at a more central point than the present one. There seemed to be some hitch in the matter, however, for he only lately became the possessor of the lot. The place is one of the best locations in Richmond for the purpose for which it is designed. It is amply large enough for almost any kind of a building which the company might choose to erect, and is situated just where the City Railway company's line turns from Franklin to go up Seventh street. Little is yet known of the character of the building to be erected, but it is said that it will be a handsome structure, which will do no discredit to the neighborhood. Y. P.

Northwestern Notations.

Minneapolis, November 9.—The electric car line between Mason City and Clear Lake, Ia., has received a shipment of steers over that line to eastern markets. This is the system which it is proposed to extend through Fertile to Lake Mills and southeast to Coldwater and Rockford.

George Weaver and George Cox contemplate establishing a factory at Stuart, Ia., to manufacture an electrical fire engine.

Bids are being taken at Grand Forks, N. D., for an electric light plant. The estimated cost is $14,000.

The city of Lancaster, Wis., has refused to grant a franchise for electric lighting, for the reason that the corporation proposes to put in a plant and operate it.

The village of Wadena, Minn., has reduced rates for electric lighting. Since the city assumed control of the plant the number of lights used has increased nearly 25 per cent.

A number of merchants of Aberdeen, S. D., contemplate putting in a private electric light plant which they can operate as they please—earlier in the evening or later in the morning than the present plant does. Nothing definite has been done.

The Western Electrical Supply company has given a bill of sale transferring its property in Des Moines, Ia., to the Iowa Electrical Construction company.

East Grand Forks, Minn., is inclined toward a municipal electric light plant.

A resolution has been introduced in the council of West Superior, Wis., instructing a committee to ascertain the cost of the city owning an electric lighting plant and to notify the light and power company that when the present contract for 100 lights expires in January it will not be renewed.

The Merchants' association of Fergus Falls, Minn., has passed a resolution requesting the council to secure sufficient dynamos to furnish all the lights for which there is demand.

The Fort Wayne Electric corporation has been awarded the contract for the electric light plant at Ortonville, for $3,500.

The large building Geo. W. Andrews is erecting for the use of Dean & Co.'s machinery warehouse in Minneapolis will be equipped with three electric elevators, one with a capacity of 10,000 and two with a capacity of 4,000 pounds.

Charles L. Pillsbury, city electrician of Minneapolis, is at work remodeling and rebuilding an elevator for the Wyman-Patridge & Co. It is to be an absolutely automatic high-speed dumb waiter and of novel construction.

The D. & D. Electric company has just completed an extensive contract, placing a 600 kilowatt dynamo and an engine in one of the buildings at the State Farm at St. Anthony Park. A large amount of electric wiring was also done. The buildings are now excellently lighted.

The St. Paul Gaslight company has submitted a proposition to the council committee to furnish the 120 arc electric lights now in use for the present contract price of $69.50 a lamp per year and to furnish 85 more lights at $85 per year each.

The street railway of Madison, Wis., will be sold under foreclosure December 1st. The debt is about $174,000. The system is now on a paying basis.

The Union Electric Construction company has been incorporated at Des Moines, Ia., with $5,000,000 capital stock.

R. R. Johnson has been granted a franchise for an electric light plant at Benson, Minn., and has had work begun on the plant. It is to be in operation by November 15th.

Bonds were voted at Whitehall, Wis., for an electric light plant.

The council of Butte, Mont., has granted the franchise requested by the Butte Street Railway company for a line to Walkerville, via Broadway.

The Rapid Transit company of Superior, Wis., will soon change its tracks to standard gauge for the entire system, beginning with the line to Duluth. Heavier rails will be put, and cars similar to those in use between Minneapolis and St. Paul, will be put in between Duluth and Superior. The work will be begun this fall.

The Electrical Workers' Union of Minneapolis has been organized with a large membership. National Secretary Kelly of St. Louis was present and made an interesting address. The officers elected were: President, O. R. Shortall; vice-president, P. F. Burns; recording secretary, W. L. Heywood; financial secretary, J. L. Wolf; treasurer, J. J. Somers; press secretary, W. F. Carpenter; foreman, M. D. Sheridan; inspector, N. Warriner. A membership of 100 is expected before the first of the year. The new union will be known as No. 24 of the National Brotherhood.

It is reported that C. E. V. Draper will make a proposition to install an electric light plant at Mandan, N. D., soon.

The Fort Wayne Electric corporation contemplates putting in an electric light plant at Tyndall, S. D.

Mail carrying on the electric street cars was begun in Minneapolis this week and is already demonstrating its usefulness. The mails are delivered to the motormen at the central office and sub-stations, all cars carrying mail bearing a sign "U. S. Mail." About sixty mails a day are carried. The street railway company gets $900 a year. The box service, which has been established on the interurban line for some time, brings $1,000 to the company. C.

Canadian Intelligence.

Ottawa, November 9.—The formal opening of the Sherbrooke, Que., electric street railway took place last week. The line, as it will be operated this winter, is about five miles in length. The East Sherbrooke line will not be opened until the spring, when the present wooden bridge over the St. Francis River, will be replaced by an iron structure.

Alderman Hallam of Toronto intimates in a letter to the mayor of that city that he is one of a company which is prepared to supply the corporation with electrical energy at a quarter of a cent per horse power per hour, direct from Niagara Falls. The Toronto Council now has before it a proposal to purchase electric energy from the Aqueduct company at one-half a cent per horse power per hour.

From an authentic source it is reported that the Niagara Falls Park and River Railway company, on the Canadian side of the river, has at length secured the right to deliver surplus power to all applicants. It is also stated that the privilege of using power has been granted to a party of capitalists on the New York side of the river, for the purpose of promoting industrial schemes, which will have an important bearing to both sides of the river.

The Hull (Que.) Electric company has purchased the Aylmer branch of the Canadian Pacific railway, which is at present under lease, the price being in the neighborhood of $100,000. The purchase only requires ratification by the Dominion Parliament. Since leasing this piece of road the Hull company has double-tracked it from Hull to Aylmer, improved the roadbed, and in other ways greatly enhanced the value of the line.

The Ross-McKenzie street railway syndicate, the chief members of which are James Ross of Montreal and William McKenzie of Toronto, will soon be the largest owner of electric-car systems in the world. The syndicate will at once begin the construction of a trolley system, 23 miles long, in the city of Kingston, Jamaica. The syndicate is keeping an eye on the transportation problem in London, Eng., and Mr. McKenzie hopes soon to obtain an opening there. Among the roads at present controlled and largely owned by the syndicate and its friends are the electric street railways of Montreal, Toronto and Winnipeg, in Canada, and of Birmingham, England.

The net profits of the Montreal Street Railway company for the year ended October 1st were $507,885.60, on a capital of $4,000,000. The company has increased its rolling stock during the year by the addition of 55 closed motor cars and 25 open motor cars, constructed at the company's own workshops; 22 more motor cars are under construction for the winter's service, and also 60 more open motor cars for anticipated increased traffic next summer. The capital stock of the company is now $5,000,000. The surplus over liabilities is $334,247.26.

The Deschenes Electric company has recently taken out a license to supply electric light and power in the city of Ottawa and county of Carleton. This company was organized in July last under a Dominion charter granted in January, 1896. The company obtained a lease from the Dominion government to lay cables from the Ottawa River at the foot of the locks of the Rideau Canal, on the Ottawa side of the river, and along the canal for a distance sufficient for their purpose. In return for this privilege the company is to supply electric current free to light the canal locks, basin, etc. It is understood the company has arranged to deliver the current to the cables of the Hull Electric company, at the water's edge in Hull. The work of laying the cables across the Ottawa River was skillfully carried out by Mr. J. E. Brown under the direction of Mr. Stevenson, the expert sent by the National Cable and Conduit company of New York. A. V. W.

PERSONAL.

Charles R. Barnes of Rochester, N. Y., was in Chicago early in the week.

E. B. Badt of Meysenburg & Badt of Chicago has returned from New York after a month's visit.

A. M. Patitz, mechanical and electrical engineer of Milwaukee, has opened a Chicago office at 1501 Schiller building.

Benjamin Butterworth, commissioner of patents, was attacked by pneumonia last week at Cleveland while visiting United States Senator Hanna. The cause of his illness is supposed to be overwork and exposure during the recent campaign in New York.

The minister of railways, posts and telegraphs of the Belgian government has advised Prof. D. E. Hughes, the English electrician, that the king of Belgium has conferred upon him the decoration of "officier de l'ordre Leopold." This mark of appreciation is due to Prof. Hughes' labors in connection with his printing telegraph instrument, which the Belgian government has largely used during the last 27 years.

The host of friends of Joseph Franklin, Jr., president of the Commercial Electrical Supply company of St. Louis, will be interested to know of his marriage on Tuesday, November 4th, to Miss Laura Allen Young, daughter of Dr. J. H. Young, rector of Trinity Church, Baltimore. Mr. Franklin is one of the most popular young business men of St. Louis, and is a member of the Mercantile club of that city. Mr. and Mrs. Franklin will reside in St. Louis.

On October 27th Mr. James Warner Kellogg of the General Electric company of Schenectady, N. Y., was married to Miss Louise Cook Pierce of New Bedford, Mass., daughter of Mr. Andrew G. Pierce of the Wamsutta Mills. Mr. Kellogg is an honor graduate of Lehigh University. His practical experience began in the engine works of the Allis company at Milwaukee. He entered the service of the Edison General Electric company as a draughting engineer. He has steadily risen until to-day he is in charge of that important branch of the General Electric company's business devoted to marine and isolated plant work. He has had the supervision of the electrical equipment of almost all the vessels of the United States Navy, and deservedly holds a high position in the esteem of his employers, comrades and business friends, who wish him all possible happiness in his new relation.

ELECTRIC LIGHTING.

Smith & Newkirk of Fowler, Ind., write that they have leased the Fowler electric light plant for three years and that they will be in the market to purchase material for improvements.

The Water Board of Dunkirk, N. Y., has acquiesced in the request of the Common Council to immediately purchase a dynamo for furnishing incandescent light for the public buildings of the city. The incandescent light system will be owned by the city and operated by the Water Board in connection with the water supply and the municipal street arc lighting. The secretary reported sufficient money in the treasury to meet the expense. It was also mentioned in the board meeting that after supplying light to the public buildings the surplus power may be used in extending the service to private consumers.

The commissioners in the condemnation proceedings of the village of Le Roy, N. Y., against the Le Roy Gas Light company have made an award of $27,850 for the gas and electric company. The proceedings were instituted by the Board of Water and Light Commissioners of the village to acquire possession of the plants for municipal purposes. Several hearings were held, all in Batavia. Arguments closing the case were made before the commission on November 3d. There is a bonded indebtedness on the plant of $25,000, and the bondholders were represented by an attorney at the hearings.

ELECTRIC RAILWAYS.

The syndicate which contemplates the construction of an electric railway from Rockford, Ill., to Dixon has purchased the franchise and right-of-way owned by James S. Bicknor of Rockford, and it is announced that the road will be built in the spring. John Farson of Chicago and Congressman Aiken of Flint, Mich., are said to be interested in the project.

At Harrisburg, Pa., November 8th, a charter was granted by the secretary of state to the Washington Westminster and Gettysburg Electric Railway company, which will build a line 14 miles long from Gettysburg to the state line. This is the company which intends to build a line to the national capital. The capital stock is $400,000, and the officers are: President, James B. Colgrove, Washington; directors, Samuel S. Bushman, Charles A. Trastel and Henry C. Little, Gettysburg; Henry A. Cady, Washington; Charles H. Duttera and John A. Shore, Littlestown.

In order that the New York Central Railroad company may get a share of the large grape shipments at the foot of Canandaigua Lake each year, it is proposed to extend the tracks of the Canandai-

gua electric railroad down through Ontario street in Canandaigua, with a switch at the freight house. Central freight cars will then be run to the lake on the electric road tracks, thereby enabling the New York Central to compete with the Northern Central, which now enjoys a monopoly of handling the grapes of the vicinity. It is also proposed to extend the Canandaigua electric road tracks through Ontario street to Wood, thence to Gibson, to Washington, to Howell, to Park, to Mechanic, to the fair grounds.

TELEGRAPH.

According to a recent consular report received at the State Department from Zurich, the total length of the world's telegraph system has now reached 7,900,000 kilometers (4,908,823 miles), exclusive of 292,000 kilometers (181,440 miles) of submarine cables. This mileage is apportioned as follows: Europe, 2,840,000 kilometers (1,764,790 miles); Asia, 500,000 kilometers (310,685 miles); Africa, 160,000 kilometers (99,419 miles); Australia, 350,000 kilometers (217,479 miles); America, 4,050,000 kilometers (2,516,548 miles). It will be noticed that, notwithstanding the steady increase in the building of telegraph lines all over Europe, America still leads and has almost double the mileage of Europe.

TELEPHONE.

The Kurtz National Telephone company of the state of Indiana has been incorporated with a capital stock of $50,000. The officers are: President, William H. Dye, 401 Lemcke building, Indianapolis; secretary, J. V. Mitchell; treasurer, John N. Cobb; vice-president and manager, William J. Kurtz. The company is authorized to do business in every county in the state. It has a plant in operation in Martinsville Ind., and it is said that 220 instruments are connected to it.

ELECTRICAL SECURITIES.

The American District Telegraph company has declared a dividend of one per cent., payable November 16th.

The North Shore Traction company of Boston reports gross earnings for September of $144,173, an increase of $12,391 as compared with the same month of last year, and net $72,758, an increase of $6,805. For the year ended September 30th the gross earnings were $1,431,936, an increase of $6,015 as compared with the corresponding period of last year, and net $613,310, an increase of $25,717.

The last quarter showed improvement in the affairs of the Rochester (N. Y.) Railway company. Owing to the fact that several of the important lines were closed part of the time on account of public improvements and street paving, the receipts fell off, but by careful management the net earnings showed an increase of $1,654, while the surplus for the quarter, $14,987, was an increase of $5,079 over that of the corresponding period of last year.

MISCELLANEOUS.

A gentleman bearing the suggestive name of Thunderbolt has patented a new electric governor which is described in the English papers.

Several valuable documents have been issued recently by the Canadian Patent Office, including "Rules and Forms" and "List of Canadian Patents from the Beginning of the Patent Office, June, 1824, to the 31st of August, 1872." The Western Electrician is indebted to W. J. Lynch, chief clerk of the Canadian Patent Office, for a set of these publications.

The Navy Department, through the Bureau of Supplies and Accounts, is inviting sealed proposals until November 23, 1897, for furnishing the New York navy yard with a quantity of battery cells, electrical apparatus, hard rubber tubing, thermostats, ventilating sets, generators, ammeters, lubricators, voltmeters, tachometers, mica, etc. Prospective bidders desiring specifications and blank forms of proposals can obtain them upon application to the navy pay office, New York, N. Y.

In a recent letter to the Philadelphia Inquirer Robert P. Porter says: "In visiting twenty-five of the leading European cities last summer, it was a matter of gratification to find how rapidly American electrical engineering is pushing its way, not only in England, but in every direction on the Continent. In London, Dublin, Cork, Bristol, Coventry, Paris, Berlin, Hamburg, Brussels, Aix-la-Chapelle, Dresden, Vienna, and as far southeast as Budapest, I found American electrical engineering has been practically adopted for the street-car systems. In fact, wherever a community was breaking away from omnibuses, or those nightmares of street transportation, the hideous steam tram cars, there I could easily discern the ingenious hand of American enterprise. Nay, more than this, for as a rule I met in charge of these works either our own countrymen, or foreign engineers who had spent years in the United States in our great electrical establishments."

TRADE NEWS.

The Cloos Electrical Engineering company of Milwaukee has been organized, with Jacob Cloos as president.

The city of Hannibal, Mo., has ordered from the Murray Iron Works company of Burlington, Ia., a Sioux Corliss engine of 450 horse power. This is to be installed alongside an engine of similar pattern that has been in continuous operation for some years, the intention being to sell more power.

The B. F. Chase company secured all the illuminated sign work for the horse show held in Chicago. It uses exclusively the Sunbeam incandescent lamp, a number being the special four candle power lamps designed especially for sign work. The Western Electric company is agent for this lamp.

The "Van" gas engine, manufactured by Van Horne, Burger & Co., Dayton, Ohio, is receiving strong words of praise from its users. The manufacturers have lately received a number of unsolicited testimonial letters which are highly appreciated. It is claimed that the "Van" engines possess many features of unusual merit, and it may pay those about to purchase gas engines to investigate the "Van" before placing their orders.

McKinlock & Camp, agents for John McKinlock, are now located at the store of the Metropolitan Electric company, Chicago, where they are busy disposing of the former stock of the Metropolitan Electric company. They are calling special attention to a large stock of porcelain tubes and other porcelain stock, as well as cut-outs, switches and sockets. These gentlemen are also desirous of making sales of a large lot of Metropolitan incandescent lamps.

The American Electric Telephone company of 171-173 South Canal street, Chicago, was very successful at the Tennessee Centennial exposition, which has just closed. It received the highest award for meritorious apparatus in the way of telephones and switchboards. The American company is to be congratulated on its success at Nashville, as it follows up, in a most satisfactory manner to the company, the previous successful competition at Atlanta, at which exposition it also received the highest award.

The General Incandescent Arc Light company says: "Owing to the unexpected increase in volume of the inclosed arc lamp business, and in view of greater convenience to our customers, we have decided to open a down-town office in New York, instead of handling business entirely from our factory as heretofore, and have accordingly established headquarters in room No. 602 Bowling Green building, 11 Broadway, and have placed in charge Fred E. Dolbier as manager of the arc lamp sales department, to which office all orders and inquiries for arc lamps should be sent."

The Jewell Belting company of Hartford, Conn., has opened a branch in Chicago in conjunction with the New Jersey Car Spring and Rubber company at 175 and 177 Lake street, where a full line of all kinds of leather and rubber belting and accessories is carried. This extension has been brought about by the continued growth of the company's business in the central and western states. The Chicago establishment will be under the management of F. G. Davis, a gentleman who is well known in the belting business, and particularly so in the Northwest, having for a number of years been located at Minneapolis.

D. A. Kusel, the St. Louis telephone manufacturer, makes this announcement: "Having severed my connection with Mr. Cuming, my former partner, I take pleasure in informing you that I have again started in the manufacture of telephones, switchboards and electrical appliances. My long and tried experience as a practical manufacturer of telephones, together with the latest modern machinery in my new factory, is a guarantee of the advantages that I possess over all other dealers in my line of goods. It shall be my greatest aim to avail myself of all the latest improvements in the manufacture of telephones and switchboards, thus enabling me to furnish all goods in my line at cheaper prices than ever before. To avoid confusion with the old firm's name in the transmission of orders through the mails, I will conduct the new business under the name of the D. A. Kusel Telephone and Electric Manufacturing company, with office and factory at 1110 Pine street. I am now preparing a new revised, illustrated catalogue, which will be ready for distribution in a short time. In the meantime, I will be pleased to quote prices on application."

BUSINESS.

Catalogue No. 29 of the Murray Iron Works company of Burlington, Ia., describes ice and refrigerating machines ranging in capacity from one to 100 tons. It will be sent on application.

The Western Electric company has furnished a room 18 by 18 feet in the rear of its store as a showroom for fixtures. Numerous chandeliers and brackets have been placed in this room, and these have been wired up with two-point, three-point, four-point and combination switches in order to show the methods by which lights in private houses may be controlled. A large variety of beautiful shades is shown on the fixtures. Five of the Western Electric enclosed arc lamps are also exhibited.

O. S. Burr, general sales manager of the Lynn Incandescent Lamp company, Lynn, Mass., is in Chicago to secure a representative for Chicago. Mr. Burr states that his company is working overtime to catch up with its orders, and that the prospects for a large winter trade are very bright.

Samuel Mankowitz, Chicago, wholesale and retail dealer in electrical supplies and materials, is carrying on a most successful business, to judge from the busy appearance of his Clinton street store. Mr. Mankowitz gives close attention to his business. He is now engaged in selling a lot of weatherproof wire. One of the features of his business is that he buys or sells electrical goods of every character; in other words, he desires his institution to be looked upon as a "bargain house" where "everything electrical" may be purchased, and where he stands willing to buy as well as sell.

Perhaps not everyone in the telephone business is aware that the Farr Telephone and Construction Supply company, 342 Dearborn street, Chicago, has issued a valuable catalogue and handbook of useful information for telephonists. This little book, which will be sent free to anyone on request, contains much valuable information for the telephone man. It gives a number of diagrams showing how to connect telephones, and to those installing telephones and not fully posted on this branch of work the book should be especially valuable. In addition, the catalogue lists a full line of the goods manufactured by the Farr company. This well-known firm claims to be able to sell telephones and kindred supplies much cheaper than other like concerns.

Western Manager Stanley Green of the Fuel Economizer company, Matteawan, N. Y., is now distributing to the many friends and customers of his company a handsome combination card-case and memorandum book. Since Mr. Green took charge of the Fuel Economizer company's business, several years ago, the business of the company has increased to a most satisfactory extent. The latest design of Green's patent fuel economizer is the result of 30 years' experience and experiment in the utilization of the waste heat leaving the boilers, for heating feed-water or water for dyeing, heating, washing and manufacturing purposes. Fuel economizers have been applied, the manufacturers state, to over 150,000 boilers, ranging from 100 horse power to 15,000 horse power plants.

Eugene Munsell & Co. and the Mica Insulator company of 218 Water street, New York, and 117-119 Lake street, Chicago, announce that they carry at all times a large stock of their "three great lines of insulation," mica, micanite and M. I. C. compound, and are in a position to supply at short notice special forms of insulation for any system of electrical apparatus. They make a specialty of the prompt filling of orders, both from their stocks at New York and Chicago, as well as at their local agencies, the Cuyahoga Supply company, Cleveland, O.; Arthur S. Partridge, St. Louis, Mo.; Sinclair Randall, Cincinnati, O., and the Brooks-Follis Electric company, San Francisco, Cal. The M. I. C. compound is their latest production, and is commanding considerable attention among the electrical trade.

William H. McKinlock and William C. Camp, agents of the successor to the Metropolitan Electric company of Chicago, are now making an extensive trip throughout the East and are at this time in New York. The purpose of Messrs. McKinlock and Camp is to visit a number of eastern houses and manufactories in order to establish a fine line of eastern connections. Messrs. McKinlock and Camp are now advertising extensively to dispose of the large stock in the possession of the successor to the Metropolitan company. With this stock as a basis it is their purpose to start an entirely new business, and the eastern trip is to establish those connections which will best work in conjunction with the new supply business they are now inaugurating. It is not known when these gentlemen will return, as they propose to cover the East very thoroughly.

The Ball Engine company of Erie, Pa., is in receipt of the following letter from Julian Kennedy, the eminent steel works engineer of Pittsburg, which refers to a 400 horse power vertical engine direct-connected to a Siemens & Halske generator: "I am in receipt of a letter from H. S. Loud, general manager of the Nicopol-Mariopol Mining and Metallurgical company's works in South Russia, in which, among other things, he says: 'The electric plant is working beautifully. You would be doing an almost obligatory service in thanking both the Siemens & Halske and the Ball engine people for me for the very great satisfaction which their machinery has given this company. The Ball engine people were especially gracious in the prints, etc., sent, and their workmanship is magnificent.' I take pleasure in advising you of Mr. Loud's appreciation of your machinery."

The Garlock Packing company is pleased to announce to engineers, steam users and the trade that it is now manufacturing a full line of cut gaskets for boiler manholes and handholes; also for all

other users. The Garlock cut gaskets are of a high grade and superior to any now on the market. With patented automatic machinery, gaskets are cut to any size and in a perfect ellipse, or round, to the requirements of customers. They are manufactured in a number of grades to meet all demands of the trade. Among them may be mentioned the Garlock gasket, the Economican gasket and the Achilles gasket. The company's perfected machinery enables it to cut gaskets from any material for special purposes. The attention of engineeers who are experiencing trouble with leaky manhole or handhole plates is invited. It is said that a single trial will convince the most skeptical that these gaskets are unexcelled by any on the market.

Speaking of electric bicycle lamps, Mr. Fletcher of the Ohio Electrical Works made an interesting statement in a recent interview in Bearings, the bicycle journal. "Our main trouble until now," he said, "was to make a solution that would run our lamp long enough, without recharging, to satisfy customers. Three and a half hours was about the limit, and that was hardly enough. We have tried for two years to better this but without success, and some big lights have had a try at it too. The other day I asked Prof. Burwell, of the Cleveland laboratory, his opinion. He looked over our formula and said it was all right, as far as it went, but what it needed was a little common table salt. We tried the experiment, but, I must admit, without much faith. The result was really wonderful, for it has doubled the life of the solution, and we can now guarantee at least seven hours of constant light without recharging. We might make a secret of this, but such is not our intention; we prefer to give it to the public and expect benefit, of course, for our lamp. You may print it in Bearings, if you like, for the fluid is good for any battery. It is made in the following proportions: Two quarts of water, one-half pound bichromate of potash, one ounce bisulphate of mercury, 12 ounces (by weight) of sulphuric acid, two ounces of salt. Dissolve the potash, salt and mercury in the water and then add the sulphuric acid; stir well when making and before using. In shipping a lamp, the potash and mercury go with it; the rest of the ingredients can be easily obtained almost anywhere, and you have an electric light at a cost not to exceed two cents a night. A small pitcher, marked inside for the proper amount of fluid to use for a charge, is also sent. Now that this vexing problem has been successfully disposed of, we shall pay more attention to the outward appearance of our lamp and make improvements wherever it is possible."

ILLUSTRATED ELECTRICAL PATENT RECORD.

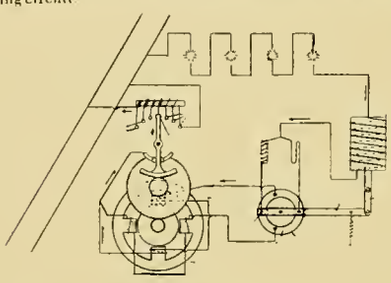
Issued November 2, 1897.

502,760. Galvanic Battery. Horatio J. Brewer, New York, N. Y. Application filed April 15, 1893.

The zinc is composed of two similar parts provided with a connector and with flanges for securing it to the battery cover, and formed with the greatest body of metal at the bottom and edges tapering toward the top for presenting the maximum metal surface at the point of greatest corrosion.

502,769. Method of and Apparatus for Relaying Telephonic Messages. Albert W. Erdman, Milburn, N. J. Application filed July 6, 1897.

The method of repeating the electrical transmission of speech between two circuits consists in transforming the electrical undulations of the voice-currents in the transmitting circuit into similar mechanical vibrations; in causing these to correspondingly vary the flow, and thereby the pressure of a current of air or gas, and in causing the air pressure vibrations to correspondingly vary the resistance, and thereby the current of the receiving circuit



NO. 593,050.

502,782. Chemical-electric Generator. Henry K. Hess, Syracuse, N. Y. Application filed May 7, 1894.

A series of negative electrodes is arranged within the electrolyte, containing a casing or shell, and a series of positive electrodes is interposed between the negative electrodes, each comprising an electrical conductor and an active material; inclosing supports for the positive electrodes are interposed between the negative electrodes, and a conduit is provided with a series of branch passages communicating with the inner chambers of the inclosing supports for discharging the active material therein.

502,802. Electric Diaphragm. Nicolas Marchal, Dieuze, Germany. Application filed January 13, 1896. Patented in Germany August 28, 1894.

An electrolytic diaphragm in the form of a plate is cut from limestone or equivalent integral natural alkaline-earth carbonate.

502,805. Electric Light Fixture. Francis B. Mason, Brooklyn, N. Y. Application filed March 19, 1895.

In an arc lamp a pair of carbon-holders is employed, with a shaft provided with right and left-hand screw-threads, a sleeve screw-threaded on the interior to fit the screw-shaft, and also screw-threaded on its exterior with a thread of a different pitch to fit a screw-thread in one of the brackets, means to secure the sleeve to either the bracket in which it fits or to the shaft, the brackets being mounted on the screws and operated thereby.

502,815. Electric Conductor and Connection and Support Therefor. William McElroy, Brooklyn, N. Y. Application filed April 30, 1892.

The support for electric conductors consists of the supporting-piece having cam projection in combination with the terminal piece pivotally connected to the supporting-piece adapted normally to be supported thereby, and having an arm adapted to engage with the cam projection upon the tilting of the terminal piece, and thereby to disconnect the latter from the supporting-piece.

502,831. Electric Railway System. William Robinson, Boston, Mass. Application filed February 15, 1895.

Included in this arrangement are the line or feed-wire, the return conductor, the working conductor formed in electrically disconnected sections, the sections being normally disconnected from the feed-wire, and a plurality of switch magnets connected in series and included in a continuously closed circuit, the magnets being operated or controlled without opening the circuit, the magnetization of the magnets respectively disconnecting the respective sections of working conductor from the line or feed-wire.

502,844. Apparatus for Electrically Treating Diseases. Henry E. Waite, New York, N. Y. Application filed August 11, 1897.

In this apparatus an air-impulse device and an electric-impulse device are arranged so that the air and electrical impulses shall be simultaneous.

502,853. Electric Battery. Alden D. Wheeler, Hyde Park, Mass. Application filed January 22, 1897.

A two-part cover of insulating material is employed, the parts of which rest one upon the other and formed to present when so disposed openings for the necks of the electrodes, and vertical flanges or ribs formed upon the uppermost part, upon which the electrodes rest and by which they are solely supported.

502,878. Dental Electrode. Francis L. Morhard, New York, N. Y. Application filed March 1, 1897.

This device is composed of a conductor having a pocket to hold the anæsthetic and a non-conducting shank adapted for contact with the opposite jaw or tooth.

502,889. Distribution Board for Electric Currents. Harold W. Shonnard, New York, N. Y. Application filed November 17, 1896.

The parallel main-circuit bars, of branch-circuit bars composed of flexible comparatively thin strips of metal, each passing beneath and connected at one point to one of the main-circuit bars and arched upward by bending to extend above and cross over the adjacent main-circuit bar, and connections therefor directly to the foundation of the board, and electric connections therefrom to the main and branch-circuit wires.

502,923. Trolley Wire Hanger. Napoleon J. St. Hilaire, Gardner, Mass. Application filed June 28, 1897.

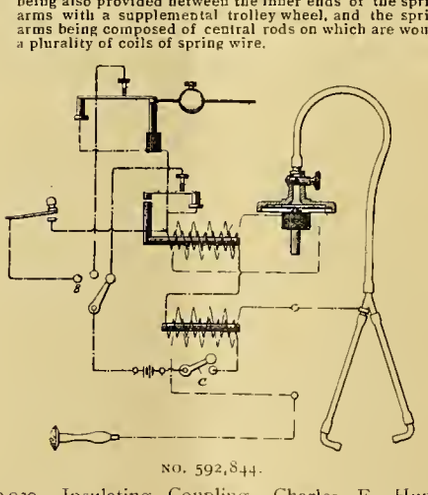
Claim is made for the combination with a frame, of jaws tulcrumed in the frame having upwardly extending ends and provided at their lower ends with recesses shaped to grip a trolley wire, a wedge having a screw-threaded portion passing through a screw-threaded opening in the upper part of the frame, and means to rotate the wedge and force the jaws to clamp a trolley wire.

502,924. Automatic Heat Regulating System. John V. Stout, Easton, Pa. Application filed June 6, 1895.

The system comprises a main valve for controlling delivery of the heating agent, a motor for actuating the valve, a source of fluid pressure, a pipe connecting the motor with the source of fluid pressure, an auxiliary valve for controlling the pressure on the motor, an electric motor for actuating the auxiliary valve, and two valves operatively connected with the auxiliary valve and with the electric motor, and serving to seal the shell or casing containing the auxiliary valve.

502,928. Trolley for Electric Cars. Elwood C. Davis, New York, N. Y. Application filed May 25, 1897.

A trolley arm is provided with a swiveled attachment, which in turn is provided with spring arms which project parallel and in the same direction as the trolley arm, the spring arms being provided at their outer ends with a shaft on which a trolley wheel is mounted, and the attachment being also provided between the inner ends of the spring arms with a supplemental trolley wheel, and the spring arms being composed of central rods on which are wound a plurality of coils of spring wire.



NO. 592,844.

502,930. Insulating Coupling. Charles F. Hummel, Brooklyn, N. Y. Application filed March 22, 1897.

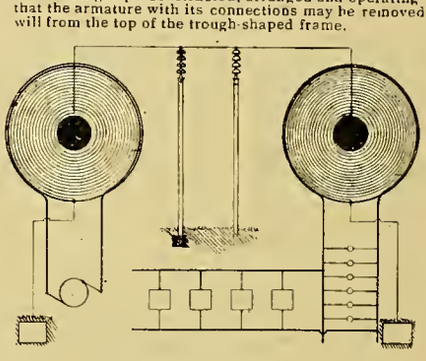
A pipe joint is described, consisting of two similar coupling heads, each of which is conical in form, and provided with a screw-threaded central bore, at the inner end of which is an inwardly directed annular flange, an insulating plate or disk placed between the coupling heads, an insulating casing mounted on each of the coupling heads, and two sleeves fitted respectively upon the coupling heads over the insulating casings, and one of the sleeves being provided with an annular rim which is screw-threaded and adapted to engage with a corresponding thread formed on the other sleeve.

502,962. Electric Signal Apparatus. Frederick W. Cole, Newton, Mass. Application filed March 10, 1896.

Two different classes of signals may be sent over one circuit—code signals and telephonic messages—by code signal and telephonic transmitters and receivers, and automatic switches for the telephonic transmitters operated by any one of the code signal transmitters in the circuit.

502,965. Electric Motor for Street Cars. Charles E. Emery, Brooklyn, N. Y. Application filed October 15, 1892.

A trough-shaped motor frame capable of being made fluid-tight, with the ends raised above the center to receive pole-pieces and with the sides forming the field yokes cut down at the armature shaft bearings, in combination with a removable pole-piece, brush-holding device and bearing-caps constructed, arranged and operating so that the armature with its connections may be removed at will from the top of the trough-shaped frame.



NO. 593,138.

503,050. Alternating Current Regulator. Daniel O. Hull, Clyde, Ohio. Application filed October 17, 1895.

To maintain a constant current in a circuit fed from alternating current constant potential mains an auto-converter is connected across the mains, a row of contact pieces is connected with the windings of the auto-converter; a movable brush is adapted to contact with any of the contact pieces; the circuit to be controlled is connected at one terminal with one of the mains and at the other with the brush, an induction motor and a solenoid, both connected in the circuit; a reversing motor switch is connected in the circuit between the solenoid and motor; mechanism connecting the movable part of the switch with the armature of the solenoid, and mechanism for transmitting motion from the motor to the converter brush being also employed.

503,094. Type-writing Telegraph. Leo R. Hammond, New Haven, Conn. Application filed May 18, 1896. Renewed September 15, 1897.

An electro-magnet and armature are utilized, together with a series of keys and a series of circuit-closers operated by the keys for closing the circuit through the magnet.

503,138. Electrical Transformer. Nikola Tesla, New York, N. Y. Application filed March 20, 1897.

A transformer for developing or converting currents of high potential, comprising a primary and secondary coil, one terminal of the secondary being electrically connected with the primary, and with earth when the transformer is in use.

503,143. Electric Railway System. Harlan P. Wellman, Ashland, Ky. Application filed May 26, 1897.

An electric railway system is described, comprising a sectional conductor, a feed in switch for each section for controlling the electric current thereto, a transformer or converter initially partially charged by the alternating current of one section of the conductor, and having its magnetic circuit normally incomplete or interrupted, and means for temporarily completing the magnetic circuit, whereby the transformer will operate the same feed in switches.

503,154. Current Collector for Electric Railways. Frederick A. Anderson, Washington, D. C. Application filed October 12, 1897.

The device consists of a standard comprising a plurality of frame bars, with conducting bars arranged between the frame bars and insulated therefrom, and terminals arranged at the top of the standard, fuse-blocks arranged in the upper portion of the standard and having recesses in which the upper ends of the conducting bars and the lower ends of the terminals are housed, whereby to insulate these parts from each other while fuses are arranged exteriorly of the sides of the fuse-blocks and on opposite sides of the standard, and means are employed to permit the ready removal and replacement of the fuses.

503,167. Electro-magnetic Circuit Breaker. Daniel C. Spruance, Philadelphia, Pa., and Montgomery Waddell, New York, N. Y. Application filed January 25, 1897.

The method of opening an electric circuit consists in mechanically breaking out by a hammer blow a section of the circuit from between two terminals and simultaneously breaking the removed section into a plurality of parts.

Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, NOVEMBER 20, 1897. No. 21

Rae's Electric Carriage.

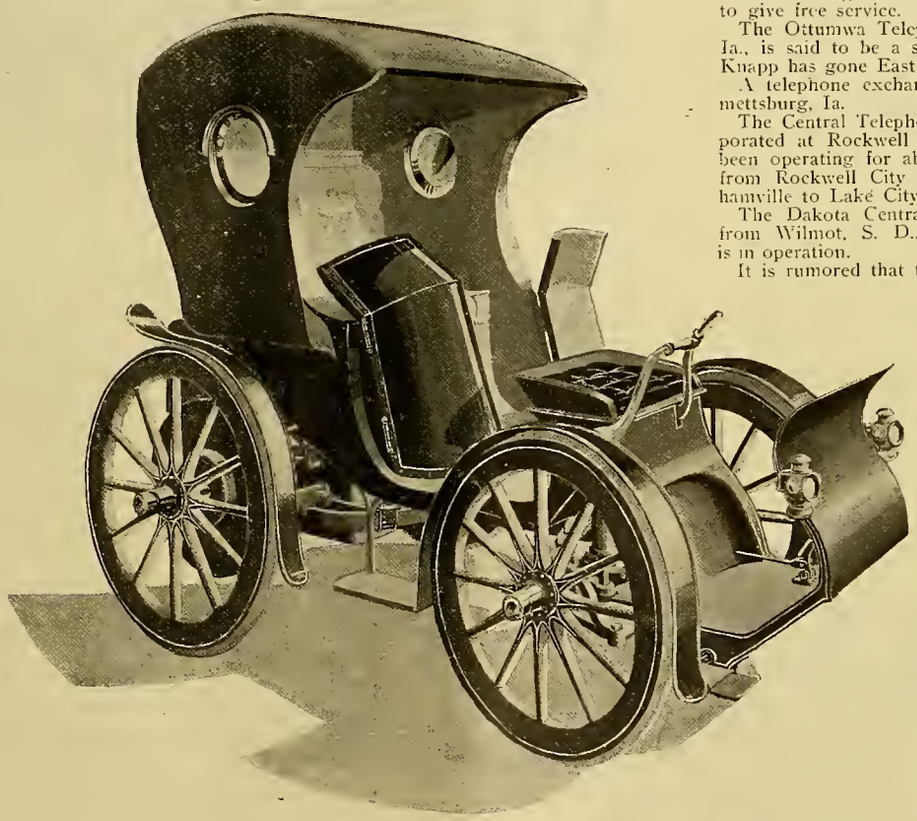
Many indications go to show that mechanically propelled self-contained road carriages are destined to have a permanent place on city streets. These vehicles seem particularly adapted for passenger service and for the delivery of light merchandise. No doubt the horse, with its many admirers, will always have a place in the cities as elsewhere, but it seems to be beyond question that many of these useful animals will be superseded by the use of vehicles carrying their own power, while it is entirely possible that in the days to come the carriage or draught horse will be as great a rarity on city streets as the horseless carriage is at present.

Of several general types of horseless carriages, the electrically propelled vehicle certainly has the advantage of cleanliness, noiselessness and safety. In appearance and ease of manipulation it is in every way admirable, and it is claimed that, notwithstanding the weight of batteries and motor, the efficiency of electric propulsion of road wagons has been thoroughly demonstrated. The electric motor has ousted the horse in street-car service; it has demonstrated its superiority to the steam locomotive for certain classes of heavy railroad traffic, and it certainly seems reasonable to assume that its advantages will be as generally recognized in the ordinary service of road vehicles, although, of course, the weight of the storage battery, as now manufactured, introduces an unfavorable complication. But even with the drawback of the heavy lead plates of the secondary battery cells, comparative tests, as in the case of the Chicago Times-Herald competition, show a higher total efficiency for the electric carriage over other types. Wherever used, electric carriages seem to be popular. In New York, for instance, the Electric Carriage and Wagon company, which furnishes cabs and broughams for hire, has just placed orders for 100 new carriages. This and the fact that the calls during June, the first month of operation, averaged 21 a day, show that electric cab service has been successful in the eastern metropolis.

Among the numerous designs for electric carriages, one of the latest and most interesting is that of Frank B. Rae of Chicago, which is herewith illustrated. Mr. Rae is an engineer of wide and practical experience. His work in electric railway and electric elevator design is well known to the electrical fraternity, and whatever he advances in machine design is sure to be worthy of respectful consideration. He has devoted much thought to his electric vehicle, which, he considers, embodies several valuable improvements. Figuring the average weight of a driver and two passengers, with a motor of 500 pounds and batteries complete, the weight of the loaded carriage is 2,000 pounds. It is graceful in appearance and is said to be capable of a continuous run of 60 miles on ordinary roads without recharging.

The efficiency of the storage battery and electric motor as applied to road vehicles has been taken to mean the efficiency at full speed and full load. Efficiencies at intermediate speeds, and particularly the starting efficiency, have not been so clearly determined. The conditions of starting and accelerating the motor-wagon, and their relation to motor design and method of motor regulation, have not, perhaps, received the attention that they merit. Current economy in starting and accelerating the load and in surmounting grades has been sought by some arrangement of the gearing or power-transmitting devices between the motor shaft and wheels by which the maximum speed and torque of the motor are reduced to the slow movement of the wagon wheels. Methods of this kind introduce mechanical complications and losses and should be avoided, of course, as far as possible. Mr. Rae insists that the conditions should be met by the electrical design of motor and controller, and, without underrating the importance of the mechanical connections to the driving wheels, he has designed his carriage to more nearly meet the conditions of practice in street railway work. Of course in the electric road vehicle the conditions are more severe, because the source of power must be carried on the vehicle, and any extreme pull upon the batteries lessens by so much the efficiency of operation. Thus, by whatever amount the watt-hours consumed in starting and climbing grades exceeds the normal output for maximum speed on a level, by that amount is the total mileage lessened for a single charge of the cells.

Mr. Rae employs a single motor geared to both rear wheels with a simple differential gear. The motor is controlled by a switch under the driver's seat, the handle of which is shown on the left in the picture. The design and arrangement of the motor are such that four speeds are obtained with four positions of the switch, the torque in inch-pounds being constant for any position when running on a level road.



RAE'S ELECTRIC CARRIAGE.

In a machine designed for a maximum speed of 20 miles per hour, which would not, of course, be reached in ordinary work, the following determinations were made for level-road running, with a tractive effort of 60 pounds per ton:

Position of controller.	Carriage speed (miles per hour)	Current at 70 volts.	Torque in inch-pounds on motor shaft.	Efficiency of motor and cells together.
1	5.72	17.8	121	64.3 per cent.
2	9.2	17.8	121	79.8 per cent.
3	13.9	24.3	121	88 per cent.
4	19.7	34.2	121	89 per cent.

From the above table it will be seen that the carriage is started and accelerated with a current draught rising from 17.8 to 34.2 amperes, the torque remaining constant. For the same machine and load on grades the following data are furnished:

Grade.	Position of controller.	Carriage speed (miles per hour).	Current at 70 volts.
Two per cent	1	2.45	24.40
Two per cent	2	6.90	24.40
Two per cent	3	10.50	32
Two per cent	4	14.60	44.50
Four per cent	1	1.60	32
Four per cent	2	5.70	32
Four per cent	3	8.73	39
Six per cent	2	4.67	38.50
Six per cent	3	7.70	46
Ten per cent	2	3.27	50

These figures are certainly of much interest. Upon them Mr. Rae bases his claim that the rating for his machine on the basis of mileage may be made upon the watt-hour capacity of the battery, with some small allowance for grades in time only, and that with 100 ampere-hour cells and a maximum speed of 15 miles per hour the vehicle could make 60 miles on ordinary roads, the current consumed being proportional to the speed. Details of construction are withheld for the present, owing to Patent Office requirements, but will be awaited with interest.

Telephone News from the Northwest.

[From the Minneapolis correspoodeot of the Western Electrician.]

The Wisconsin Telephone company is giving free service at Centralia, Wis., to about 25 persons, to compete with the home company. A local paper remarks that before there was competition it was different. When the Wisconsin Telephone company extended its lines to Centralia it took an inducement of $700, but now the company is willing to give free service.

The Ottumwa Telephone company of Ottumwa, Ia., is said to be a sure go. Manager Edwin A. Knapp has gone East to purchase materials.

A telephone exchange will be installed at Emmettsburg, Ia.

The Central Telephone company has been incorporated at Rockwell City, Ia. The company has been operating for about a year and owns a line from Rockwell City to Churdan and from Farnhamville to Lake City.

The Dakota Central Telephone company's line from Wilmot, S. D., to Brown's Valley, Minn., is in operation.

It is rumored that the Iowa Telephone company will put in an exchange at Albia, Ia.

J. H. Jansen has been reinstated as manager of the Wisconsin Telephone company for the northern part of Wisconsin.

The Central Wisconsin Telephone company is installing a telephone exchange at Black River Falls, Wis.

The Wisconsin Telephone company has begun work rebuilding its exchange in Menomonie, Wis. A new switchboard and entire new office appliances will be put in. O. K. Ranum, who has been manager of this office for 13 years, has resigned and will devote himself to the drug business hereafter.

The American Telephone and Telegraph company will make an effort to secure a franchise for long-distance connection at Duluth, Minn. The company will have to build a line from the Twin Cities, 150 miles, as there is no long-distance line passing through Duluth.

Jones & Winter of St. Paul have the contract to construct the Wisconsin Valley Telephone company's line from Shell Lake to New Richmond, Wis., and have begun work.

The Houghton County Telephone company is receiving substantial encouragement in Houghton, Lake Linden and other towns in the Upper Peninsula of Michigan. The company has 250 subscribers and about 100 shares of stock taken.

The Northwestern Telephone Exchange company attempted to cross the right-of-way of the Chicago, Milwaukee and St. Paul Railway company in Faribault county, Minn., but the railroad company refused permission, because it has a contract with the Western Union Telegraph company for the exclusive privilege. Suit was brought at Wells, Minn., and the court decided for the telephone company, and appointed a commission to fix damages sustained by the railroad company.

The Northwestern Telephone company of Shebogan, Wis., has ordered a 400 drop switchboard to replace its present one, which is a 300 drop board.

The Mutual Telephone company of Des Moines, Ia., now has nearly 1,000 instruments in service.

The Chicago and Northwestern Telephone company is the name of a new company for which articles of incorporation are now being prepared at

Eau Claire, Wis. It is a project of J. E. Keelyn, and its purpose is to cover Eastern Wisconsin and Northern Michigan and connect with the Wisconsin Valley Telephone company. The latter company has for its territory the district bounded by the Twin Cities and Winona, Minn., on the west, Ashland and Superior on the north, Wausau, Wis., on the east, and Madison, Wis., on the south. This company proposes to build independent exchanges in all towns of importance that have none now, and will connect with all such exchanges as are established. New exchanges are to be put in at Eau Claire, Chippewa Falls, Stevens Point, Ashland and other points.

James Harper of the Northwestern Telephone company has been attending to business matters at Atwater, Minn.

By means of the Wisconsin Telephone company's service every incident of the football game played between the Wisconsin and Minnesota universities a short time ago was followed by President Adams and a body of students at Madison, Wis., throughout the afternoon.

Telegraphs and Telephones in Persia.

Vice Consul-general John Tyler at Teheran has forwarded the following interesting report to the State Department:

The first telegraph line in Persia was erected about 36 years ago, and in the beginning was vigorously denounced and opposed by the priests as being a species of magic and closely allied to other evil principles greatly subversive of religion and the best interests of the state, and, as such, ought not to be permitted to have a place in the economy of government. This opposition, however, was overcome, and it will be seen further that the class which resisted so stoutly at the first now use the telegraph with the most complacent indifference.

In the year 1862 the construction of a telegraph line from India to England, through Persia, Russia and Germany, was commenced, which was completed and in working order on the first of January, 1870. Some work had been carried on for three or four years, however, by a line through the Euphrates Valley, but this was not by any means of a satisfactory character, and serious errors, delays and interruptions on the lines and in the messages occurred. This line is still used occasionally, but the transmission through Turkey cannot be depended upon.

The Indo-European, as the line now passing through Persia is called, is the joint property of the Indian government and a London company. The meeting point of their respective administrations is in Teheran, the eastern division belonging to the government, and the western to the London company. It is generally considered to be a well constructed and efficiently managed line. From Bushin to Kurachi there is both a cable and a land line, worked throughout by English operators. I mention this line, because it provides the local native administration with one wire, which, so far as internal traffic is concerned, is the only one that can be depended upon.

The local lines, with the exception of the one wire mentioned above, are the property of the Persian government. The ownership was acquired by the cost of construction, and has been maintained by defraying the expenses of preservation. The actual administration is deputed to one man, who, until about two months ago, contributed to the government 12,000 tomans ($12,000) a year. This royalty has now been raised to 30,000 tomans a year, but I am told that the balance of receipts over expenditures will hardly be sufficient to meet the increase.

As Persians are very indifferent bookkeepers, and do not always study with care the relation between outlay and income, I regret to state that the record of telegraph construction has been no exception to that rule. I have not, therefore, been able to ascertain from any source what has been the actual cost of the creation of the lines. The configuration of the land surface and the state of the population, generally scant, would curtail the cost of construction. The poles, wires, etc., have been transported by mules and camels, which would also reduce the expense considerably. The lines bing subject to many accidents, and the inspection and control very indifferent, the working is by no means satisfactory.

The yearly receipts of the telegraph have been about 60,000 tomans. As no new lines have been erected for some years past, the above is probably a fair average. I must, however, remark here, that when any department of the government revenue depends upon the system of farming, the income of the parties interested is always made to appear as low as possible, in order to prevent an increase in the government demand.

The expenditures, including the late rise in the revenue payable to the government, will, I am told by the comptroller, equal, if not exceed the income. They are, therefore, attempting some reforms, which certainly seem to be needed, especially in the direction of compulsory payments. I am informed that fully 50 per cent. of the telegrams are sent gratis. Officials of the government, central and local priests, expounders of the law, relatives of persons connected with the working and administration, and everyone who can provide himself with a reason or an excuse, send their telegrams free of expense. As this system has been growing for many years past, and most of those who have benefited by it are in positions to give trouble, the management finds it difficult to introduce changes necessary for their own protection.

The Persian local system comprises about 31,000 miles of wire and 86 offices for the receipt and dispatch of messages. The wire, provided by the Indo-European administration gratis, is about 1,300 miles long and extends from the Persian Gulf to the Russian frontier.

Stamps are not used for any purpose in Persia, except for letters. Even documents of great value and importance give no indication of the cost of registration or other legal formality.

Messages are restricted to 10 words at a charge of 2½ kraus (25 cents). The actual charge for the message is two kraus, and the one-half krau is for the paper on which it is written. In case the message extends to a large number of words it is calculated at the rate of 10 words to the two kraus.

The tariff above mentioned is the same for any distance, great or small, in Persia. I find that the administration do not tabulate any department of the work, consequently they have no idea of the number of words or the general or average distance the messages are sent.

The Persian newspapers rarely contain information of sufficient importance to be sent by telegraph, consequently there is no press rate and very few press messages.

There are four newspapers in Persia printed in the vernacular and under government control. These should be issued once a fortnight, but they are often issued at longer intervals. They are in no sense considered as leaders or exponents of the ideas or feelings of the people, and I am of the opinion that they are hardly accorded the importance they desire and deserve to attain.

It would be utterly impossible to estimate what is the actual value of the work performed by the Persian telegraph in the course of a year. I am told that a large percentage of government work is never paid for, and it has been already shown what number of people use the line free of charge.

The late minister of telegraphs, who died a short time ago, and who had been charged with the management from the introduction of the lines into the country, was a man of a benevolent disposition and easy-going character, and in order to keep free of opposition allowed those who had the power to injure his position to use his department for their advantage. Another order of things has sprung up, and his eldest son, who has been confirmed in his place, finds it difficult to make both ends meet.

The late Nasredin, shah, on the 8th of December, 1889, granted to the then minister for foreign affairs a concession for electric lighting, the introduction of telephones, phonographs, and the application of electricity to industrial purposes for the whole of Persia, with protection to the monopoly for the period of 60 years. This concession was transferred to Dr. W. W. Torrence, an American citizen, for a certain valuable consideration; but from want of means the purposes of the concession have not been put into execution. In order to prevent the concession from lapsing two or three wires were put up and kept in a working state and are now in use.

Five years ago the Railway and Tramway company commenced erecting private wires for anyone who would undertake the expense, and established a telephone exchange office on their own premises in Teheran. It has not been extended to any other town. So far no record has been kept of the number of miles of wire erected, but from my observations I should say not more than 50 miles, including the wires into villages of summer resort, and those to different parts of the city.

At the present time there are 15 owners of pri-

FIG. 2. SUBTERRANEAN ELECTRIC LINE AT BUDAPEST.—KIOSK AT DEAK STATION.

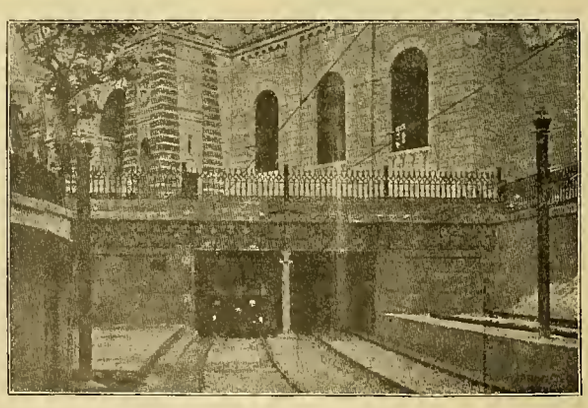


Fig. 1. Tunnel Entry at City Park,

Fig. 3. Metallic Roof of Station.

SUBTERRANEAN ELECTRIC LINE AT BUDAPEST.

vate telephone wires, each of whom pays the company $2 per month for keeping the wires in repair and the instruments in order. The receipts about balance the expenditures, but this includes the free use of the lines by the company, who provide the only office there is in the city, and in the country during the summer months. As messages are not received from the public no tariff has been formulated; subscribers are put into communication and use the telephones as long as they wish. The cost of construction has been about 390 tomans per kilometer. As a more extended use of the telephone would interfere with the receipts of the telegraph, permission to use it has not been granted to distances appropriated by the telegraph. No laws or regulations have been issued by the government in connection with the telegraph or telephone.

Subterranean Electric Line at Budapest.

The Hungarian capital possesses an underground electric railway which has attracted a good deal of attention because of special features of construction and equipment.

The commencement of the line is near the quay of the Danube, in the central part of the city. This line extends to the city park, a distance of 3,700 meters. There are 11 stations along the route, nine of which are below the surface, while two are on a level with the surface, and are located within the public grounds. The tunnel entry at the city park is shown in Fig. 1. This tunnel is a divided arch, with a row of columns running through the center, and provided with two footways, each one meter in width, the space above narrowing to 0.65 meter. The roadway of the passage is built on I girders, with intermediate arches. The footpaths are entirely of cement, and the iron girders of the roadway are protected from rusting by several coverings of felt saturated with asphaltum. The metallic roof of one station is shown in Fig. 3.

a white light at the last station, showing the track clear over the block just vacated, while at the station in advance a small red signal indicates that the road is occupied—a train is coming. Each station is equipped with telephones, so that if necessary these can be used in place of the automatic block system.

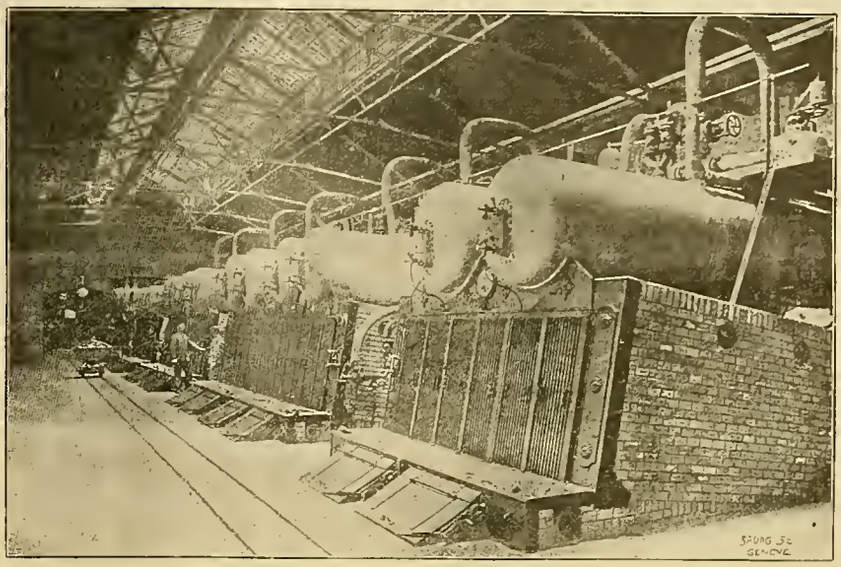


FIG. 4. SUBTERRANEAN ELECTRIC LINE AT BUDAPEST.—BOILER PLANT.

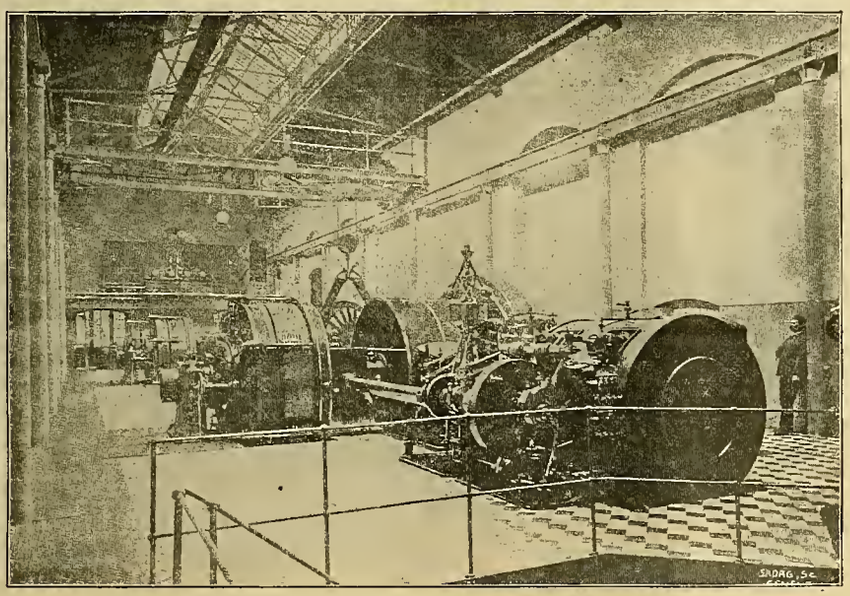


FIG. 5. SUBTERRANEAN ELECTRIC LINE AT BUDAPEST.—DYNAMO ROOM.

The underground stations are reached by stairways through the kiosks. One of these at Deak station is shown at Fig. 2. These stairways are from 1.9 to 2.5 meters in width and have from 19 to 24 steps each.

The power station equipment consists of four multitubular boilers of 267 square meters of heating surface, as shown in Fig. 4, and two compound condensing engines, each actuating one directly connected Siemens & Halske dynamo, Fig. 5. Each dynamo generates 1,100 amperes at 300 volts, but on occasion the capacity can be increased to 1,400 amperes. The chimney has an internal diameter of five meters, and a height of 50 meters. Current is carried from the distributing board at the central station by armored lead cables. There are also separate cables for supplying current for illuminating purposes and for the operation of the block and telephone systems. At intervals along the line arrangements have been made to enable the central station men to couple the underground system in parallel with the surface lines, both systems of feeders being below ground. The feeders of the subterranean lines are of 500 square millimeters section. The two cables arranged for the illumination and the block systems are of 150 square millimeters section. Underground the wires are suspended from the ceiling, while above ground they are carried on transverse lines from posts. The feeders below are of copper bars, 50 millimeters high and weighing five kilogrammes per lineal meter, while overhead they are of hard-drawn copper of 10 millimeters diameter; the sub-feeders or trolley lines are naked cables. The lamps used are for 100 volts, three in series.

A block system is employed in which each train, as it passes a station, makes contact which lights a red signal at the station, and simultaneously lights

The coaches of the road have flexible trucks, as shown in Fig. 6. The motor acts directly on the axle. The distance between trucks is eight meters, and the length of the coach between couplings is 11 meters, while the width is 2.35 meters. Seats are provided for 28 passengers and standing room for 14 more. There is a private compartment for the conductor and trainmen. Twenty coaches are operated on the line, 14 of which can be placed on the road at one time, following successively at intervals of 10 minutes. One-half the coaches have motors with two poles and the rest with four poles. The weight of a coach is 15 tons.

During the first five months of operation the number of passengers carried was 2,261,940, and the kilometers run amounted to 369,680. The franchise allows a maximum fare of 4.2 cents, during the first 15 years, and allows the city the right of purchase (by giving a previous two years' notice) in 1940.

Increased Traffic on "Chicago "L" Roads.

The traffic of the Metropolitan elevated road has increased 45 per cent. since the opening of the Union Loop. The report of Receiver MacAllister for the month of October filed in the Federal Court contains the following statement:

Cash on hand, Oct. 1st....	$168,256.35	
Receipts from fares	76,678.55	
Receipts from privileges ...	2,849.35	$247,784.25
Disbursements—		
By order of court.....	$ 57,754.83	
Receiver's operation expenses—		
General	$15,013.04	
Pay rolls	27,796.08	$ 42,809.12
Cash on hand, Nov. 1.....	$147,220.30	$247,784.25

The report for September showed $57,204.80 credited to fares. The report for October shows $76,678.55 credited to fares, so that there is a gain of $19,473.75 on three weeks' use of the Union Loop. Disbursements have increased $31,517.55, nearly all of which is on court vouchers for extensions in rolling stock equipment. Pay-roll disbursements are slightly less.

In the items of expenses the amounts refer to the payments made only, and practically equal the expenses of the previous month, for the pay-rolls and bills are met the first of the month following that in which they were incurred. Loop rentals had not yet been paid.

The receiver's report shows that the loop has caused a daily average increase of about 45 per

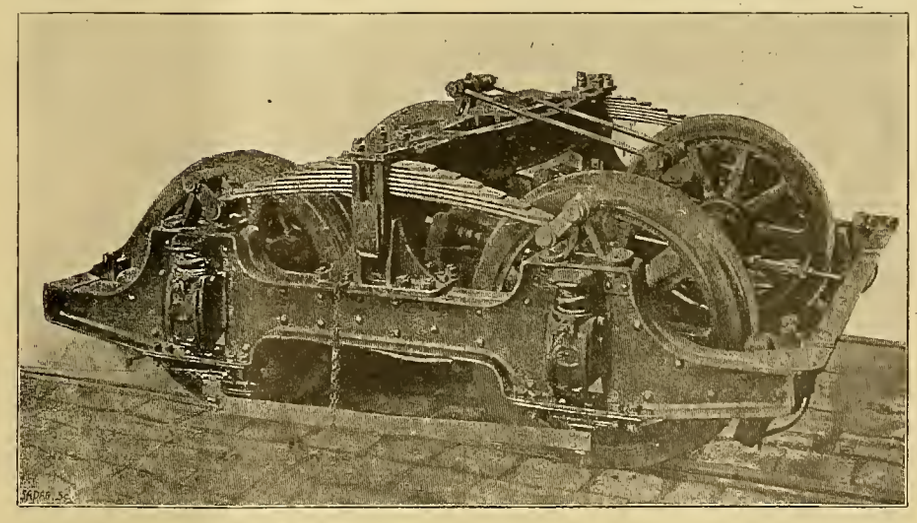


FIG. 6. SUBTERRANEAN ELECTRIC LINE AT BUDAPEST.—TRUCK EQUIPPED WITH FOUR POLE MOTOR.

cent., the daily average traffic now being at slightly over 60,000. The following are the receipts from fares in past months of this year: January 20th to February 28th, $86,647.45; March, $74,108.90; April, $68,318.90; May, $62,546.90; June, $63,076.05; July, $57,669.20; August, $58,635.10; September, $57,204.80; October, $76,678.55.

The Union Loop company's first bills for the October rentals of the three lessee elevated roads were due last week in accordance with the terms of the leases, but are not quite ready for presentation. The amounts to be charged up against each of the roads for the use of the loop will not be given out. From known data of average daily traffic on the three lines since their use of the loop it can, however, be approximately estimated that the Union Loop company will come out ahead quite handsomely in its first monthly account.

The Alley "L" used the loop for 14 days during the month. During its first week of the loop it carried 334,206 passengers and during the second week 336,026, making a total of 670,232, so that the amount of the loop rental it contributes, at the one-half cent per passenger rate, is exactly $3,351.16.

The Metropolitan's daily traffic since its use of the loop from October 10th averaged 60,000 per day, according to the receiver's report, or 1,260,000 for the 21 days. The rental of this road therefore would approximate $6,300.

The Lake Street's present daily traffic, according to the deliberately conservative statement given out in Judge Grosscup's court, since the completion of the loop, has been 36,000 per day. This amounts to 1,008,000 passengers carried during the 28 days' use of the loop. Consequently the rental bill for October would foot up to $5,040.

The total of these three rentals amounts is $14,691. The total average number of passengers carried over the loop on one day is thus 144,000 in round figures, which, at the same average for one year, would amount to 52,560,000; and at the rate of one-half cent per passenger the whole loop revenues from this source for one year would be $262,800—which is $12,800 more than the minimum rental amount which the roads using the loop guaranteed to pay.

It would thus appear that even if the Northwestern elevated should never use the loop or should be relieved of its one-fourth part of the $250,000 annual guarantee, the other roads would have no deficits to make up, and the Union Loop company without demanding of the other roads payments to cover deficit would have sufficient earnings to pay interest on its $5,000,000 of bonds, and also something to pay on its stock. The sale of advertising privileges would also be a remunerative item, and as the year progresses traffic on the elevated roads is likely to show still further good increases, as evidenced already in the weekly increase records of Alley "L."

Union Loop operating expenses, which, according to the lease agreement, must be borne jointly by the roads, have not as yet amounted to much. The five per cent. payments to the city on receipts after interest on bonds has been deducted will not begin until January 1st. So far as the three elevated roads are concerned the 10 per cent. which they must pay to the Union Loop company out of the gross receipts from fares will inflict no hardship on them, with an increase of nearly 50 per cent. in the traffic of Alley "L" and Metropolitan, and of 33 per cent. in the traffic of Lake Street. Union Loop bonds have risen about 10 points within the last four weeks, and now sell at 97 and 98.

Electric Railway for Klondike.

Among the schemes that are engaging the attention of the people in the Klondike region is one reported from Seattle, Wash. James Hopkirk of Oakland, Cal., who is said to have superintended the construction of the Washington state building at the World's Fair, is negotiating with contractors for the erection of an electric elevated single-track railway from Skaguay over the White Pass. He said: "I have solved the problem of transporting passengers and freight from the coast to the lakes in the quickest, cheapest and safest manner by means of an electric elevated single-track railway, that can be built in 90 days at a cost well inside of $100,000, with a capacity only limited by the number of cars in use. The track consists of 12 by 12 inch posts, six feet high, 14 feet apart, on top of which are strung two timbers, each 6 by 12 inches, 28 feet long. On top of the timbers is a 30 pound steel rail on which the cars run.

"The cars are 15 feet long, seven feet high and four feet wide, capable of carrying three tons each. Two cars are joined together by heavy beams and run one on either side of the rail, making practically one car. Two heavy car wheels support the load and two 15 horse power motors are needed, one for each wheel. The cars weigh 2,500 pounds each, exclusive of the motor, and can be built for less than $100 each. The bottoms of the cars run two feet above the ground.

"The cars are steadied by wheels at the bottom, set with a spiral spring which takes off the oscillation. The cars can turn on a radius of 50 feet and with a 15 horse power motor can climb a 17 per cent. grade. Two trips a day can easily be made and a double car carries six tons.

"I am now negotiating with a syndicate to construct a road over the Skaguay trail, and expect to get well under way inside of three months."

Electrically Driven Flour Mills.

Since the completion of the great three-phase electric power transmissions on the Pacific Coast, between Folsom and Sacramento and the San Joaquin and Fresno, the use of electricity as a motive power has made great strides. Two of the most important flour mills are now added to the already long list of consumers.

The first to be placed in dependence on electric motors was the Sperry flour mill of Fresno. This is driven by a General Electric synchronous motor of 150 kilowatts capacity, running at 600 revolutions. Fig. 1 shows this motor, with a small bipolar motor to bring it up to speed, in the basement of the mill, whence the main belt passes to the rolling and grinding machinery above.

The second mill is the second in importance on the Pacific Coast and the largest flour mill in the United States using electricity instead of steam. Its electrical equipment consists of three General Electric three-phase alternating current induction motors operating at a pressure of 500 volts. The largest of the three motors (Fig. 2) has a capacity of 75 horse power. This is belted to the main shaft of the mill and drives all the flour-making machinery. It runs continuously for 24 hours, and for three months without stop. The second largest motor is one of 30 horse power, and is shown in Fig. 3. This occupies a position on the second floor of the mill and drives all the cleaning machinery. It runs continuously for 18 hours daily. The third is a 20 horse power motor, and is placed in the basement near the 75 horse power motor. This drives the roll for grinding the corn and the barley. Its work is intermittent and it runs from eight to 10 hours per day only.

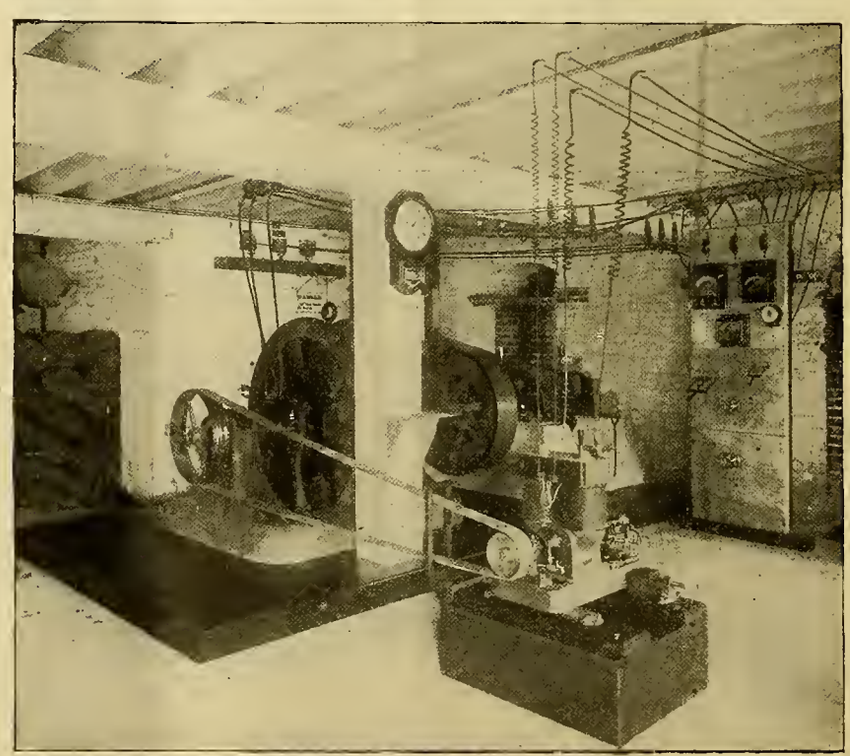


FIG. 1. ELECTRICALLY DRIVEN FLOUR MILLS.—150 KILOWATT SYNCHRONOUS MOTOR, SPERRY FLOUR MILLS.

The power consumed by the motors is registered by means of recording meters, which show the total horse power of current consumed. These meters register exactly the power used and allow the company to keep a careful watch upon its machinery and obtain the highest economy in operation. For instance, when the cleaning for the day is completed and the 30 horse power motor and all the cleaning machinery are shut down, all expenses for power in that department cease at once. No power is wasted in running idle shafting and belting. The same is true in a still greater degree in the corn and barley crushing department, where the work is more intermittent.

Still another source of saving lies in the fact that neither engineer nor fireman is required to operate the mill electrically. The motors are so simple in their operation that any employe about the mill can handle them. To start the motor a simple switch is closed and a lever on the motor thrown over. In less than a minute the motor begins to perform its full load of work and continues without further attention from the operator. The stoppage of the motor is an equally simple process. No attention is required beyond this, except that entailed in keeping the motor lubricated. Power is always ready at call, but the mill is not put to one penny of expense for power after the machinery ceases to operate. In addition to this economy, the wear and tear on belts, bearings and machinery is reduced to a minimum by the system of subdivision of power which has been adopted. The cost of hauling coal from the river to the mill, which is in the center of the city, is also saved. It is estimated that the economy in actual power consumed in the Phœnix Mill by the present method of driving is not less than 15 per cent., and the total saving in the entire cost of operation will, it is said, pay for the electric motors, their installation and adaptation, in less than one year.

In addition to the economy in the operation of the mill by the introduction of electricity as the motive power, a considerable amount of space has also been saved, as will readily be realized, and the room formerly occupied by the driving machinery can now be utilized for other machinery or for storage purposes. The present capacity of the Phœnix Mill is 275 barrels of flour and 20 tons of rolled barley and feed, every 24 hours, and the entire output of this mill is taken by local consumption, none of the product being shipped outside the state. It was due to the careful investigation of the subject by Mr. J. H. Arnold, the manager, that electricity was adopted as a motive power. He is already reaping his reward for himself and his company in benefits constantly accruing.

Production and Utilization of Ozone.

The Commercial Ozone Syndicate, Limited, has been engaged for a year in the experimental application of ozonized air, ozone being produced by means of the Yarnold apparatus, which is based on the principle of the so-called "silent discharge" of an electric current at high potential, certain devices and improvements in construction being introduced, by means of which a high efficiency or yield of ozone per electrical horse power has been obtained.

The plant employed by the syndicate, as described in the London Electrical Review, consists of a drier (an apparatus for passing atmospheric air through freshly-calcined lime to remove excess of moisture and carbonic acid), a Roots blower for air delivery, ozone generators and step-up transformers, a compressor to deliver ozone at pressure, and suitable zinc and galvanized iron piping for delivery of the ozonized air. The alternating current of electricity is supplied at 100 volts, this being raised by specially constructed step-up transformers, standing in oil, to 12,000 volts or over. The plant gives an output of 1,800 to 2,000 cubic feet of ozonized air per hour. The ozone generators have been in continuous use for nine months, and for long runs of several days and nights' duration they have exhibited very excellent working qualities.

The cost of the ozonized air, as produced and utilized by the syndicate, is stated to amount to less than 1d. per 2,000 cubic feet, based upon the rate for electrical energy at 4d. per unit. If surplus power was available for driving a dynamo, the cost could be considerably reduced.

Experiments have been carried on in a thorough manner, under two experienced chemists for several months, in connection with the drying and thickening of linseed oil for painting and linoleum manufacture, also in expediting the seasoning of linoleum and in the manufacture of the peroxide of hydrogen for disinfecting and bleaching purposes. It is found that linen and cotton yarns and fabrics can be effectually bleached without the ill effects arising from the use of chemicals. Great success has attended the application of ozone in cleansing brewers' foul casks ("stinkers"), and exhaustive tests have

been made by large brewers, a leading firm having it in contemplation to erect a plant to treat practically the whole of its casks, in order to ensure a uniform quality in the output of the beer.

It may be pointed out in connection with this purification of casks, that apart from the actual ozone production plant and compressor, no expensive special apparatus is necessary for the application of the gas to the foul casks, the ozone being conveyed by a little additional piping to the steam nozzles already in use at all breweries, and injected under pressure, together with steam, into the casks under treatment. The price of ozone being low, its application in this direction must result in great saving to the brewers, as a 36 gallon cask costs about 25s., and is usually worthless when it becomes foul. Such casks number thousands yearly in large breweries, and it is calculated that at Burton-on-Trent alone the loss, owing to the hitherto impossibility of curing these casks, amounts to over £100,000 annually. Wine and spirit casks can be equally effectually treated.

Elaborate experiments have been carried out on the drying and thickening of linseed and such like oils with most satisfactory results. A special apparatus has been constructed for the treatment of 20 gallon charges, and oils so dealt with surpass, in color and drying properties, the best boiled or other drying oils on the market. The process is said to cost about 4s. per ton of oil, against 10s. per ton by the ordinary methods, and it is claimed to obviate the danger of fire and heavy insurances involved under the present "boiling" system.

As regards linoleum, it is found that the exposure of the raw product at the usual heat to a current of ozonized air effectually seasons it in a few days, against weeks of drying in the ordinary manner; the colors also are found to be greatly improved.

Peroxide of hydrogen is well known for its disinfecting and bleaching properties, and it is found that this can be very cheaply produced by ozone, in a simple and inexpensive apparatus, and can therefore be used for many purposes, impracticable, hitherto, on account of the prohibitive price. By its agency linen and cotton yarns and fabric can be cheaply and expeditiously bleached, and it is said that the most delicate silks and the finest yarns suffer no harm by exposure to this bleaching agent.

Ozone can be used for the sterilization of water it has been proved satisfactorily by Dr. Frölich that it effects purification of water, killing bacteria therein; and for sanitation Dr. Ohlmüller, of the German Imperial Sanitary Board, reports that anthrax, typhus and cholera bacilli, as well as anthrax spores, are destroyed within a few minutes by ozone. Ozone is known to be a powerful agent in sanitation, and it is a fact that it has the property of fixing the ammoniacal compounds, converting them into nitrates, and so increasing the utility of sewage as a fertilizer.

It has been found by the medical profession that ozone can be used in alleviating the distressing symptoms in cancer and malignant growths by destroying the offensive smell. It can also be used by inhalation, and mitigates bronchitis and asthma.

Dr. S. Rideal, F. I. C., public analyst, made careful experiments with ozone gas to determine its action on arsenical pyrites, and has given the following opinion as regards the action ozone on ores (Yarnold's process): "From my experiments on this process for the treatment of arsenical ores, I am of the opinion that the process might prove useful for the preliminary treatment of refractory gold ores, and so render them suitable for treatment by the ordinary cyanide process, and that it is well worth a certain expenditure of capital in order to test the feasibility of the process on a commercial scale so soon as you have secured your patents."

Dr. Rideal also writes: "I am strongly of the opinion that there is an enormous commercial future for cheap ozone. . . . From the demonstration at Mr. App's in December last, I am of the opinion that the Yarnold apparatus can be worked most economically, and that ozone manufactured by it would be available for many industrial uses."

The use of ozone in metallurgical and chemical operations is a field which has yet to be explored.

The following are the names of some technical authorities who have investigated and reported on the action and use of ozone, viz.: Dr. Frölich, G. Clapperton, Dr. Ohlmüller of the German Imperial Sanitary Board; D. S. Rideal, Drs. Tabbe and Oudin.

Electrically Driven Turntables.

A source of much annoyance and no little expense to railroad companies is the turning of locomotives and cars at division points and terminals. Workmen are not especially employed for this service, but engine wipers and helpers about the engine house are called upon each time the turntable is used. The number of men that usually assist in this work is four, two at each end of the table, and the time they lose from their regular duty is considerable, as they are frequently in the pit under an engine in the engine house, on top of the engine, or at some other inconvenient place to get away from when called, and their movements are slow. Then they frequently engage in conversation when meeting. This takes up time that should be devoted to other purposes.

The general master mechanic of the Baltimore and Ohio Southwestern estimates that it costs 12 cents to turn each engine by hand. Observing these delays and the expenses attending them, the Railway and Engineering Review says that one of the master mechanics about 2½ years ago devised a plan for turning the 60 foot turntable at Chillicothe, Ohio, by means of an electric motor. This motor was applied to an old car wheel by cast-iron spur gear wheels, so as to reduce the speed. The car wheel and motor were attached to a frame which was hinged to the girder of the turntable, the car wheel to run on the circular rail or the track of the turntable. It was found that the weight of the frame, motor and car wheel was sufficient to give necessary adhesion, so that the tractive force would easily turn any engine.

On trial it was found that the heaviest engine could be turned completely round in 56 seconds. The current is carried to the motor by an overhead wire which is connected directly over the center of the turntable by two brass rings insulated with hard wood so that a perfect contact is always given, thus furnishing a good conductor for the current to the motor. The current is controlled by a rheostat so the motor can be run in either direction and at such speed as may be desired. This is done by a simple lever which is moved back and forth.

The cost complete, including motor, did not exceed $500, and after 2½ years' use the device seems just as good as when constructed, and has given such satisfaction that it was decided to operate the turntable at Park street, Cincinnati, O., in a similar manner, except that the current is taken underground and connection made around the center cone of the table so that all wiring is concealed, thus presenting a neater appearance.

The electric power is purchased from the Union Depot company through a meter. The cost of this power for four months, May, June, July and August, was $29.

This turntable is used on an average of 50 times each day, thus making a cost of less than one-half cent for each time the table is turned, while if it were operated by hand, using figures of the general master mechanic (12 cents for each engine), it would have cost $738, which shows a saving of $709, no cost being allowed for repairs; the repairs, however, will never be very expensive.

The Baltimore and Ohio Southwestern has just completed a plan for equipping the turntable at Garrison shops, Ind., with a device similar to the one in use at Chillicothe, O., and will have it in operation in a few weeks. An even better showing can be made there than at Park street, Cincinnati, as more use is made of the table.

Electricity Direct from Heat.

In a note presented to the French Academy, according to l'Electricien, Marcel Deprez discussed the problem of developing electricity direct from heat, and offered some interesting suggestions.

"The only process with which we are acquainted for producing electromotive force direct from heat is that discovered by Seebeck, exemplified in the thermo-electric battery," he said. The eminent investigator continued: "I propose to show a second process, based on the remarkable magnetic properties of alloys of iron and nickel, the discovery of M. Guillaume.

"It is a known fact that M. Guillaume has shown that these alloys can be rendered strongly magnetic at a certain temperature and become non-magnetic with a rise of temperature of but 50° C. In designating by n the percentage of nickel in alloy with iron, and by T the temperature at which its magnetic properties disappear, we will have a formula, sufficiently exact for the purpose, as follows:

$$T=34.1\,(n-26.7)-0.80\,(n-26.7)^2.$$

"In an alloy 26.7 per cent. the complete loss of magnetism occurs at zero. In all the alloys of iron and nickel the thermal interval between saturation and perfect loss of magnetic property is about 50° C.

"Assuming in this formula n=30, T will =104° C. An alloy of 30 per cent. of nickel will then almost completely lose its magnetism at 100° and be strongly magnetic at 50°. This alloy is chosen for the following example:

"Suppose that we construct an apparatus comprising a horse-shoe magnet, between the poles of which we place a bundle of wires of the alloy named, perpendicular to the axis of the magnet and parallel to the line of the poles, so that the magnetic circuit is closed by the bundle, of which the extremities touch the inner faces of the magnet. Around this bundle, as a core, we wind an insulated wire, thus making an armature which is connected to an exterior conductor. When the temperature falls below 50° this core will become strongly magnetic, and develop a flow of magnetic intensity.

"If now we heat this to 100°, the conditions change and the magnetism will disappear almost completely; if we let θ represent the time necessary to produce this elevation of temperature and F the flow of force of the armature, the mean electromotive force developed in each spire of the bobbin will have a value of

$$\frac{F}{\theta}$$

and give a current of which the mean intensity will be

$$\frac{N\,F}{R\,\theta}$$

R being the total resistance of the spool and the exterior circuit, and N the total number of turns.

"If now the coil is cooled from 100° to 50°, we will have an equal electromotive force but of contrary sign. This apparatus is therefore a generator of alternate currents."

Heilmann Electric Locomotive.

A successful test of the latest form of the Heilmann electric locomotive was made at Paris on November 12th. The train hauled by the locomotive weighed about 200 tons. The trial was intended chiefly to illustrate the reduction of vibration and the regularity of movement of the new machine. This was demonstrated, but the speed did not exceed 18 miles an hour.

The locomotive resembles the hull of a torpedo boat. The wheels are scarcely visible. The locomotive is 18 meters long and weighs 125 tons. It is regarded as a great improvement on Heilmann's first engine.

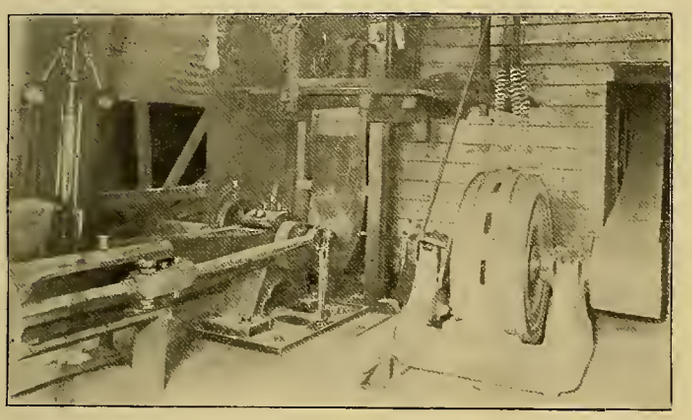


Fig. 2. Seventy-five Horse Power Induction Motor Driving Flour Making Machinery, Phoenix Flour Mills.

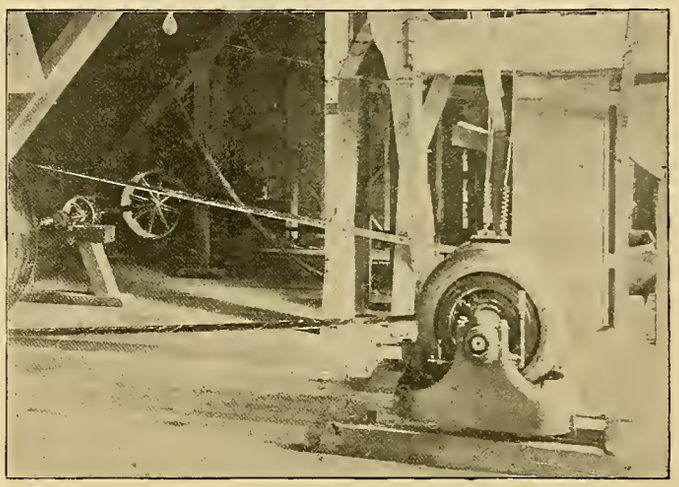


Fig. 3. Thirty Horse Power Induction Motor Driving Cleaning Machinery, Phoenix Flour Mills.

ELECTRICALLY DRIVEN FLOUR MILLS.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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State of Illinois, County of Cook—ss:
Thomas Jansen, being duly sworn, deposes and says that he is a resident of the city of Chicago, in the county of Cook and state of Illinois, and that he is the foreman of the printing department of the Electrician Publishing company, the publishers of the Western Electrician; that he was present at and superintended the printing of No. 24 of Vol. 20 of the Western Electrician, issued on June 12, 1897, and that there were printed by actual count 20,000 complete copies of said Western Electrician of the volume and number above specified. And further this affiant sayeth not.

THOMAS JANSEN.

Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

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Governor Pingree of Michigan delivered an address before the Nineteenth Century Club in New York on November 11th, and as usual his remarks were highly entertaining, although they could scarcely be considered instructive. Parts of his address were really amusing and much of his language was picturesque, but, sad to relate, the governor frequently indulged his propensity to exaggerate. It is evident that the Michigan statesman has lost none of his admiration for the reform mayor of Detroit; in fact, the New York deliverance was a glorification of the three P's known in common parlance as Potato Patch Pingree, but officially interpreted as Citizen Pingree, Mayor Pingree and Governor Pingree—a great trio, indeed, but evidently the list is incomplete in the estimation of the bumptious Michigander.

No wonder expert testimony is regarded with suspicion. In Brooklyn recently a physician testified in a damage case that he had examined a patient, who was plaintiff in the action, under the fluoroscope in order to corroborate a diagnosis. Immediately the opposing attorneys demanded similar examination by physicians of their own selection. This was permitted and every facility was afforded the physicians, the X-ray apparatus being set up in court. The result of the investigation was evidently unsatisfactory to the defense, for the physicians testified that the fluoroscope could not be relied upon. One of the experts said that he did not consider the fluoroscope trustworthy, "because the flickering of the light makes things appear abnormal when no abnormality exists." The jury evidently considered the physicians' testimony inconsistent with their action. At any rate it disregarded this evidence and awarded damages to the plaintiff.

After a careful investigation of the subject of magnetism and electrolytic conductivity, G. Milani contends that the announcement of Neesen, 13 years ago, that a strong magnetic field is capable of modifying the conductivity of a solution of ferric chloride, which would be of paramount importance to the theory of electric conduction, is not true. In recent experiments a U-tube was employed, carrying the liquid and provided with side tubes, through which a pair of unpolarizable electrodes was introduced. The latter formed the terminals of a very sensitive capillary electrometer and consisted of the capillary ends of siphon tubes leading into bottles containing saturated $ZnSO_4$ solution and a rod of amalgamated zinc. The magnetic field was generated by a large horseshoe magnet 1.2 millimeters long. Alterations of temperature were precluded by the rapidity of the measurements. The dimensions of the tubes, the concentration of the solution, the currents and magnetic fields were varied in every possible manner. A difference of resistance of about one-half per cent. was apparently produced, but this was almost entirely suppressed by a perfect insulation of the electrometer wires. The result of these observations is the conclusion that Neesen's effect either does not exist or is so small that its existence cannot at present be demonstrated.

An important subject for the consideration of the executive committee of the National Electric Light association at its meeting next Monday evening will be the determination of the time and place of holding the next meeting of the organization. Omaha and Indianapolis have already presented their claims, and friends of both cities are urging the members to give favorable consideration to their petitions, but there appears to be a reluctance about accepting either of these invitations displayed by many prominent and influential members, and in some cases opposition to the plan of holding the convention either in Indianapolis or Omaha has developed. There is unquestionably a growing sentiment in the association against the practice of constantly changing the place of meeting, and a plan to hold the conventions alternately in New York and Chicago has many earnest supporters. These considerations will no doubt largely influence the executive committee in reaching a decision, and the action of that body next Monday evening will be regarded as an indication of the general sentiment on this subject, as it is known that an effort has been made to ascertain the views of central station men in all parts of the country. There are many advantages in the proposed plan, not the least of which is the opportunity that will be given central station managers of studying the practice of the large plants operated in these towns and of examining the methods of metropolitan companies. Superior accommodations are to be had and the location and railroad connections are also in favor of the larger cities. It is not necessary to present in detail the merits of this city and New York as meeting places. They have already been tested by the National Electric Light association, and that experience is the best recommendation that can be given. Chicago will extend a hearty welcome to the National Electric Light association. The Western Electrician voices the sentiment of the electrical interests of Chicago and the West and of the business interests of Chicago in extending a cordial invitation to the National Electric Light association to hold its next convention in this city.

Objections to municipal ownership of quasi-public enterprises are succinctly set forth in a statement of the reasons which governed the mayor of Philadelphia in signing the lease of the city gasworks to a private corporation. Among the points raised by Mayor Warwick the following will appeal to business men: "The constant succession of administrations every four years, the consequent changes in the heads of departments, the inability to continue by reason of these changes a settled, definite policy looking to one end, must prove to every thinking man that these conditions greatly interfere with the successful operation of any business enterprise." The mayor rightly concludes that "there is no private business that could prosper under such a system." In view of the experience of Philadelphia in this matter the following expression by Mayor Warwick is of interest: "It is a grave question in my mind whether or not any municipality should operate any manufacturing industry." It has been demonstrated that city employes could not operate the works except at a considerable loss to the taxpayers, yet there seems to be no question that a private company can pay a fair rental for the plant, give first-class service and earn a fair return upon the investment in spite of the expense to be incurred in putting the plant in good condition. This illustrates the difference between public and private management of such enterprises.

The following communication from W. R. Brixey, which appeared in the New York Herald of November 14th, will prove interesting:

My attention has been called to the article in this morning's Herald [November 11th] headed "Great Wire Trust," in which it is stated that among the prime movers in the attempt to form a monopoly of the leading American insulated cable plants to control the industry is the Kerite factory.

I am the sole owner of the Kerite factory, and wish to deny that I am a mover in any such enterprise. I am the only individual owner of any of the factories mentioned in the article, manufacturing rubber insulated wires and cables. I know of no reason why I should sacrifice a business that has been established since 1860. If any of the other companies named are in such straits as to require them to form a trust to monopolize the market the same should not be attributed to me.

I always have been and still am prepared to carry out the contracts which I undertake, without the assistance of my competitors.

Conflicting statements of the nature and extent of the proposed combination of rubber wire manufacturers have been circulated, but one thing is certain, and that is that an effort will be made to regulate prices and control the product of the principal factories. That it will fail eventually, as have all similar attempts to control other branches of the industry, is to be expected, particularly as the proposed trust cannot invoke the protection of patents. It would seem as if the combination would merely invite additional competition and result in the formation of new companies. The experience of the incandescent lamp makers should serve as a warning against such combinations. It is safe to say that the lamp business of the country is in worse condition to-day than at any time in its history prior to the formation of the combination.

As far as Mr. Brixey's denial is concerned, it would seem as if the reasons which he gives for not going into the proposed combination are perfectly valid and should apply with equal force to any concern in the position which he describes.

It may possibly interest others connected with the proposed combination of wire manufacturers to know that there is at least one large concern in Chicago that will probably engage in the manufacture of rubber-covered wire in case the combination is formed.

Civil Service Examination for Governmental Positions as Electricians.

All electricians or wiremen who desire to enter the service of the government are now required to pass a civil service examination. Vacancies in the departmental service in Washington do not often occur, but when they do they are filled from what is called the "eligible" list on the records of the Civil Service Commission; that is to say, one of the three persons at the head of the list of the whole number of persons examined is chosen to fill the vacancy. The post of electrician or wireman comes under what is called at the Civil Service Commission the "third grade," and all applicants must pass a general examination, given in common to all persons who desire to enter the departmental service in that grade, such as engineers, elevator conductors, attendants at the Government Insane Asylum, microscopists, firemen, map-printers, messengers, model-repairers, skilled laborers and watchmen. Three hours are allowed the applicant for answering questions in the basis examination, and four hours for the practical examination. Three considerations govern the determination of the average for the two examinations.

There are five subjects embraced in the third grade basis examination—spelling, arithmetic, letter writing, penmanship and plain copying. The spelling is dictated by the examiner, the words being usually those in common use, the examiner pronouncing each word plainly and giving its ordinarily accepted definition. In arithmetic simple tests in addition, subtraction, multiplication, division and United States money are made. The applicant is required to write a letter on some subject, given by the examiners, chiefly to test his knowledge of simple English composition and his general intelligence. The fourth subject is penmanship, the marking being determined by legibility, rapidity, neatness, general appearance, and by correctness and uniformity in formation of words, letters and punctuation marks in the exercise of the fifth subject, copying some article given the competitor. The principal point observed is absolute accuracy, every comma being of importance. General experience and the age of the applicant are also taken into consideration. All applicants for positions in this grade must be at least 20 years of age.

Anticipated Inventions.

It is curious to reflect, says the London Electrical Engineer, that many of our so-called modern inventions have been invented long before and forgotten, but that this is so many authorities can vouch. We are so constantly hearing of them that they pass almost unnoticed, and our revelry in the newness of them remains undisturbed. An author writing on this subject in an evening contemporary a short time ago referred to an early discovery of the electric telegraph, which may have escaped the notice of many of our readers. Arthur Young was on a visit to Mr. Lomond, at Paris, in October, 1787, when he saw what he describes as something very remarkable. He says: "You write two or three words—Mr. Lomond takes them with him to his room and turns a machine which is enclosed in a cylindrical case. A wire connects it with a similar cylinder and electrometer in a distant apartment. His wife stationed there, by remarking the corresponding motions of a ball, writes down the words they indicate. Length of wire makes no difference in the effect." Mr. Young does not go into details, probably for the very reason that they were beyond him, but it is somewhat remarkable that, considering how much we know of Mr. Lomond as a savant of his time, we have no other record of his discovery. The Revolution was responsible for a good many things, and perhaps the forgetfulness of this invention must be attributed to the same disturbing element.

National Electric Light Association.

President Insull has issued a call for a special meeting of the executive committee of the National Electric Light association, to be held on Monday, evening, November 22d, at the Holland House, Fifth avenue and Thirtieth street, New York, at which time matters of considerable importance to the association will be taken up. It is quite probable that the time and place for holding the next annual meeting will be determined. There seems to be considerable opposition to Omaha, which was considered the most likely place during the last convention. Indianapolis is in the field and is making a strong canvass, but it seems to be pretty generally agreed that Chicago will be the selection. President Insull has refused to take any part in the controversy and has even refused to express an opinion, as he did not wish to influence the committee in the matter.

Electric Railway Depot under a Church.

A branch of the London Metropolitan underground railway has one of its stations directly underneath a church, that of St. Marie Woolnoth. The edifice is over 200 years old and in the midst of a bustling thoroughfare in the heart of the city, where a depot was of paramount importance. But it was also of great importance to retain the character of the structure in order to preserve intact the title to the property. Accordingly a spacious vault was constructed underneath the church for the accommodation of the railway traffic, and the original building was in no way disturbed, although it boasts a bell tower and two wings, the mass representing a weight of 1,500,000 kilogrammes. The ceiling of the vault is supported by steel arches which rest on 20 massive columns of cast-iron. At the right and left of the church stairways lead to the vaulted depot, and there is also an elevator which enables passengers on the King William street branch to reach this underground station.

Franklin's Neglected Grave.

[From the Philadelphia Times.]

Benjamin Franklin's grave is in a neglected condition. No appropriate stone rises over it, the ground round about it is uncared for, and the tomb of the great scholar and statesman is as obscure as that of a man whose name and fame were no part of the glory of his country.

His grave is destitute even of a headstone. It is covered by an old-fashioned marble slab which was placed there a hundred years ago, and is now worn and discolored by age.

Nothing has been done to it since Franklin was buried there, and even the modest arrangements of the grave are not kept in the perfect condition that is expected of a great man's tomb. The earth on all sides is bare of grass, the common thatching of the commonest grave, and an air of desolation is about the whole place.

The sexton said that the descendants of Franklin would not do anything to repair the grave, neither would they allow anybody else to do anything. Every day he has received offers of subscriptions from visitors, who are distressed by the forlorn appearance of Franklin's resting place and who would like to see it improved. In reply he says, as he has been instructed, that Franklin wished it so, "being a plain man averse to display of any kind." Not long ago, at his own expense, he had the fading inscription recut, or else even the only distinguishing mark, the name, would be gone.

If he had not done so, the last resting place of the greatest man, outside of Washington, in American history, would have been forgotten and unknown. Who is responsible for this condition of affairs? Not the living relatives of Franklin. The responsibility rests with the American people, to whom the man belongs. They should see to it in the future that what little is there to mark the grave is kept in better order than it has been in the past.

Before he died Franklin provided for his own gravestone and instructed a stonecutter of his acquaintance in every detail, even to the inscription which was to be placed upon it. He desired to be buried beside his wife, who had died some years before, and a common slab was to be placed over them both. The inscription arranged as he ordered it reads:

BENJAMIN and DEBORAH } FRANKLIN
1790

Everything was done as he desired, and the work was paid for out of his estate, and stands to-day the same as when he died.

Röntgen Society Formed in London.

A new scientific society has been formed in London that is to be devoted to matters relating to Röntgen radiation, and has been styled the Röntgen Society. The honor of being the first president of this new fraternity has been conferred upon Prof. Silvanus P. Thompson, whose work in this field has been particularly valuable. As a result of these investigations, Dr. Thompson has published a volume on "Light, Visible and Invisible." It is an elaboration of the series of lectures delivered by Dr. Thompson at the Royal Institution, at Christmas, 1896. To each reprinted lecture there is appended a useful series of notes and comments. "Röntgen Light" is the title of one of these lectures, which is naturally a synopsis of the views of the best authorities upon this phenomenon. The newly formed Röntgen society will find plenty to do in studying the nature and action of these rays.

Theory of the Induction Coil.

The theory of the induction coil is as yet in an imperfect state as far as the mechanism of the interrupter and the constitution of the primary circuit are concerned. B. Walter, who conducted some investigations lately, worked with a peculiarly efficient coil, provided with a condenser and a silver-and-mercury interrupter working under a layer of petroleum. He introduced condensers of various capacities, and determined their effect upon the length of spark obtained in the secondary circuit. It was found that the length greatly increases with the capacity up to a certain limit, which was 0.2 microfarad in his coil, and then gradually diminishes. This may be explained by the method devised by Braun, which consists in making the magnetic field deflect a narrow beam of cathode rays impinging upon a fluorescent screen, and drawing out the vibrating spot into a curve by means of a revolving mirror. The "make" current is thus seen to describe a regular logarithmic curve, as required by the theory, while the "break" current, on the other hand, falls evenly to zero. The fall is made more rapid by the introduction of a small capacity, thus giving a higher spark potential in the secondary circuit. The condenser, which serves to absorb the current, may, if large, actually retard the extinction of the current. At 0.22 microfarad distinct vibrations set in, which at first go to increase the rapidity and extent of the fall, but at 0.9 microfarad the wave-length of the vibrations is sufficient to flatten out the curve and reduce the electromotive force in the secondary circuit. It should be mentioned that this method of observation is only available when the secondary circuit is open, since otherwise the magnetic effect of the primary is canceled, but vibrations actually exist under all circumstances, as is shown by the intermittent appearance of the secondary spark. Generally speaking, it may be assumed that the maximum value of the secondary electromotive force is directly proportional to the maximum intensity attained by the primary current and to the square root of the inductance of the secondary coil, and inversely proportional to the square root of the capacity of the primary condenser. A crucial experiment showed that the spark-length is strictly proportional to the maximum value of the primary current. If this is generally true, then the voltage corresponding to a spark one meter long would be 650,000, and to a lightning flash 200 meters long a voltage of 130,000,000.

Municipal Ownership.

[From the Chicago Chronicle.]

Arising mainly from the fact that valuable municipal assets have been bartered away by bribed municipal authorities, there has arisen in the United States a sentiment which is not at all confined to professed socialists that there should be municipal ownership of public business that is in its nature monopolistic. We may, however, in adopting any such changes contemplated go incontinently from the frying pan into the fire.

Explaining why the gas plant of Philadelphia, owned by the city, was leased, Mayor Warwick said: "If the plant were in a first-class condition, working satisfactorily and giving a good quality of gas to the consumer, the lease would never for a moment have been considered, but the constant complaints of our citizens and the inability to secure sufficient appropriations for the improvement of the plant should be argument enough to show that the works should be leased to an experienced, responsible company, able to furnish the money for the improvements required and so organized that it can at once take hold of the works and operate them without delay."

In this instance of ownership the city was an absolute loser. The explanation, in a word, is the spoils system, and it will be idle to talk of municipal ownership of illuminating plants, telephone outfits and intramural transportation businesses that must have the city's assent in order to their operation until there is firmly grounded, not through a passing sentiment, not through a splurge of reform, but as an essential and matter-of-course policy of muncipalities, an undisputed merit system that shall not make employes the sport of charter elections. We cannot be certain that a merit system even if adopted is to abide until it has become part of the accepted tradition of municipal government.

Even then the wisdom of municipal ownership of such business may be doubted. No government agency is as alert and profitable as an interested private agency. It is desirable to continue the private agency in furnishing the supplies or the accommodations that are requisite in such matters, but not upon such terms as have prevailed hitherto in the majority of the cities of the United States. The city must share and share alike with the private company, for it contributes to the partnership an essential part of the business. Without municipal grant the private corporation cannot do business. The grant, therefore, is as valuable as any money capital that the private corporation may invest. The grant should be placed against the capital, that the partnership may be equal, and the profits should be to the joint account of the private corporation and of the public corporation. The direct benefit to the people in car transportation would be a reduced fare, but since it seems impossible to obtain that the next best benefit to the people is the municipality's share in the profit made on transportation.

Year in and year out dividends have been paid upon the stock of street railways in Chicago anywhere from 8 to 20 per cent. Five per cent. is regarded as a very desirable return upon the investment of capital, and why should not the city, which contributes the most essential capital to street railway companies, have half the company's dividends? The asset the municipality puts into this private company is an asset immediately capitalized for millions of dollars, and yet the city receives next to no compensation at all.

The subject ought to be thoroughly discussed before any additional grants are made to the local intramural transportation companies or to any concerns looking to a profit out of a municipal grant.

It is rumored that an electric light plant will be installed at Westby, Wis., soon.

Inferior Service of Government Telegraph System.

It really seems to us, says the Newcastle (Eng.) Chronicle, the postoffice authorities deserve to be complimented on having reached perfection in the art of mismanaging one branch of the business with which the nation has foolishly entrusted them. The postoffice has carried its mismanagement to such a pitch of perfection as to deprive the very word "telegraphy" of a portion of its signification. Writing in 1892, Mr. Preece, the chief engineer of the telegraph department, explained that while "telegraph" was "a general name for any means of conveying intelligence other than by voice or by the transmission of written messages," "the idea of speed is generally misunderstood." The idea, thanks to the postoffice, is now excluded. What is now connoted by "telegraphy" is delay, vexation, loss and chaos.

The London Daily Mail, commenting on the failure of the telegraph service, says: The abnormal delay in the telegraph department of the postoffice continues. On Tuesday all previous records in this respect were beaten. The central gallery presented the appearance of a decorated chamber in honor of some festive occasion, so numerous were the slips drawn from the Wheatstone instruments, placed with methodical accuracy on the pegs in the room, awaiting transcription. And they hung there, not for one hour or two, but for three, four and five hours. They were messages for the most part from Liverpool, messages from the merchants of that city to their clients in London. They had telegraphed in the fond hope of a speedy delivery; they have yet to learn that their hope was in vain. The officials of the department were at their wits' ends to know how best to grapple with the difficulty, and ended by not grappling with it at all. The telegraphists, on the other hand, regarded the extraordinary situation with comparative unconcern, although the oldest among them admitted that they had not seen the like before. Some with a facetious turn of mind wanted to know when the man was coming around to dust the slips, and make them look fresh again. The matter, however, is of serious moment to the public, who are the sufferers. Here is a list of a few towns where the delay was severely felt on Tuesday:

Liverpool	5 hours
Brighton	2 hours
Margate	2 hours
Oxford	2 hours
Peterborough	1½ hours
Aldershot	1½ hours
Sheffield (with special arrangements to avoid delay)	1½ hours

The Daily Mail is among those who have suffered inconvenience and annoyance. A glaring instance occurred on Monday evening, when the new comic opera by Mr. James Glover and Mr. Arthur Sturgess was produced at the Grand Theater, Birmingham. The dramatic critic of the Daily Mail made a special journey to the Midland City to furnish a description of the performance and to record the verdict of the audience on the new production. He faithfully discharged his mission, and the fact that there was no mention of the piece in Tuesday's issue is unreservedly due to the unaccountable delay on the part of the telegraph office. An hour and 55 minutes elapsed between the time the message was handed in at Birmingham and the time it reached the Daily Mail office in Carmelite street. It was coded as being received at the Birmingham office at 11:47 p. m. It reached St. Martin's, according to the code time on the message, at 1:02 a. m., and it arrived at our office exactly 40 minutes afterward.

As no apology was forthcoming from the telegraph officials for such an astounding performance, an explanation was sought. A representative of the Daily Mail called at the central office on Tuesday and saw Mr. Nops, the superintendent of the department in which press messages are dealt with. He explained the facts to that gentleman; he produced the useless flimsies; he pointed out the absolute loss which had been incurred in consequence of the delay in sending a representative especially to Birmingham; and he invited Mr. Nops to be good enough to give some explanation that might serve as a solatium for the annoyance which had been caused. Mr. Nops examined the flimsies carefully, took a note of the fact that the code times were accurately stated, and admitted that there had been serious delay, but without investigating the matter thoroughly he could not offer any more satisfactory explanation. Then an idea struck him. Perhaps the dramatic critic of the Daily Mail had sent the same message to other papers. He was assured that such was not the case. Perhaps, ventured Mr. Nops, the critic had handed the message in at a branch office, and it had to be transmitted. It was pointed out that unless Birmingham was different from other large towns, branch offices were not kept open, in the ordinary course of business, until 11:45 in the evening. Mr. Nops acquiesced, and then went on to explain that at this time of the year there was a great rush of telegrams. The representative ventured to think that this was hardly possible just before midnight; and then Mr. Nops, poor man, pointed out that it might have been that, owing to the lateness of the hour, the staff at Birmingham had been reduced, and that that was accountable for the delay. At all events, he made a note of the matter, and promised that it should receive his earnest consideration.

Another System of Motive Power.[1]

Chief among the almost numberless mechanisms which have undergone striking development since the application of electricity to commercial ends are prime movers of the various types. Notwithstanding that the steam engine is still the machine which most satisfactorily answers to the demands of electrical power supply generally, the attempts to apply other engines and motors to the same service have wrought marked improvements on the same. The result has been that not only have engines and motors employed in the electrical industries been very much improved, but the skill in design and workmanship which has evolved as a natural outcome of attempts to provide the best for the demands of electrical requirements has also extended to most all other industrial lines as well, and produced a much better class of energy transformers throughout. Especially is this statement true as applying to water wheels and gas engines. Although as yet the speed regulation of these two types of machines has not been brought to within anything like the same measure of control obtained for steam engines, yet such machines are constantly being brought out in units of increasing capacity, and under conditions offering an approximately full load factor their operation has reached a measure of success which may be said to meet with general satisfaction.

In traction work a progressive betterment of power generators and motors corresponding in degree to that achieved in power machinery in general has ensued. In the short space of time since this development began, electric motors using power transmitted from central stations over conducting wires have taken the lead almost exclusively over other means installed for propelling cars employed in local passenger traffic in densely populated districts, especially where such traffic is handled on public right-of-way, in streets and highways; and the manner in which the service thereby secured has been able to compete for business with parallel lines steam equipped bids fair to lead to the eventual adoption of the system by many steam roads now operating under conditions which render the electric motor more adaptable to the work than the steam locomotive. Nevertheless, the limitations on the field open to the trolley or third rail (the latter being in principle a trolley) system appear to be such that no machine heretofore displayed yet gives promise of supplanting the steam locomotive in long-distance transit not supplying sufficient traffic for close scheduled trains. The loss in power through transmission to trolley cars over distances exceeding about 10 miles from a power station is so great that any inherent advantages which make the system the most profitable one for shorter distances are counteracted. As, however, the distances in what may be termed rapid-transit fields of traffic are continually increasing, necessarily there arises a demand for some mechanism better adaptable than the steam locomotive, which shall in the larger field carry with it the advantages possessed by the trolley-system within the limitations of its field. Projects suggested to fulfill these requirements make up a long list, but naturally there is sought some scheme comprising a motor car which is self-contained. With the experiments on compressed-air locomotives and storage battery cars most engineers and mechanical men are more or less familiar. The compressed-air locomotive fails of fulfilling the desired requirement from the fact that its supply of air must, at periods corresponding to more or less definite distances run, be replenished from a plant located at some point central to its range of operation, and the storage battery car fall short of accomplishing the purpose for similar reasons. The desire to equip a car with machinery possessing the rapidity of acceleration possible with the electric motor, and at the same time be independent of a stationary generating plant or power station, has been so great as to lead to the bold construction of one which practically concentrates all the essential parts of a power station on wheels. Those cognizant of comparatively recent developments will easily recognize a reference to the Heilmann locomotive, for the last three years considerably experimented with in France. Notwithstanding the large losses known to follow, through the numerous transformations which take place in this machine, yet the advantages to be had in uniform torque at starting, and the high speeds which may be attained without rapid reciprocating motion (such motion being confined to the comparatively low-speed engine which drives the generator), have enlisted sufficient faith in the outcome of the scheme to furnish means for the fitting out of several machines of magnificent proportions, no expense being spared to provide complete designs on lines of modern improvement.

The highly fluctuating loads necessarily imposed upon machines employed in traction work has hitherto excluded the gas engine from all such service therein as might be considered beyond the experimental stage. While it will be seen that this machine has been tardy in the process of gaining public recognition, nevertheless it is believed that principles are involved which afford a solution in one way of the problems above outlined, and ising to at least justify a thorough investigation into its merits. Although its development as thus far exhibited might be considered an insufficient demonstration of an expected economy in fuel consumption and cost of operation, yet there is a conviction that at least one important question has been settled, namely, the entire feasibility of the scheme and its reliability of action in work within the range of its capacity.

It is believed that the idea involved in the make-up of this machine presents a scheme of accomplishing a long looked-for achievement, namely, that of employing a prime mover working under practically a constant load. The well-known losses incident to the employment of power generators of sufficient capacity to perform the requirements of train acceleration have led to considerable effort to provide means of storing power, to the intent that smaller generating machines sufficient in capacity only to maintain speed after the acceleration has been accomplished could be employed. The only arrangement thus far found to be practicable for the accomplishment of this purpose on trolley roads is the installing of storage batteries in the power house to assist the generator in taking care of overload during the periods of heaviest traffic, morning and evening. Practically the same idea is involved in the arrangement of the machinery in the motor car under consideration, and with prospects of even greater success. The economy of gas engines operating under conditions permissive of their use is well understood, and their safety and reliability of action under such condition call for but small expenditure for attendance. The experience recently had with storage batteries in traction work is such as to relieve the situation of any doubt as to their trustworthiness and their ability to withstand arduous service. In this case the fact that they are not drawn upon except during occasional periods of overload, and then not as a rule to any considerable degree of exhaustion, would make the work imposed on them less severe than that endured in simple storage battery traction, and a consequent slower deterioration ought to follow. As the reliability of the gas engine under, or up to, the point of full load is not questioned, and the providing of storage battery cells in parallel groups of sufficient number to furnish capacity for any degree of overload on the machine is perfectly feasible, the ability of this machine to handle any loads not without the total capacity calculated upon would seem to be assured.

The question as to the economy to be had in the use of this machine for ordinary traction work might not stand in the way of its use under certain conditions of traffic where cost of fuel does not enter largely into the total cost of operation. For instance, there are steam lines of considerable length on which the local traffic in passengers and freight is not sufficient to pay the expense of operating trains equipped in the ordinary manner with steam locomotives and the necessary attendance upon motive power and train. Machines of this type, of capacity sufficient to handle trains large enough to accommodate the passenger and freight demands of small roads, could be built at far less cost than steam locomotives and operated at an exceedingly small expense for attendance. There are also trolley lines operating but few cars, where the use of a system of this kind might save the expense of power house construction and equipment and still effect some saving in the cost of furnishing power.

1. om the Railway and Engineering Review.

Remarkable Coincidence.

Few men identified with the electrical and allied interests are so well known as Dan Hemingray of Covington, Ky., who with John Hamilton figures in the following story, which is taken from the Cincinnati Enquirer:

"Perhaps one of the strangest experiences I ever had was in connection with the terrible Ashtabula accident," said Hamilton. "It was by the narrowest escape that I missed it. I had been in that city for a day and a half, and had made arrangements to take that very train, when as I stepped out of the hotel I had some trouble with a stranger. He was about half drunk, ready to fight and when I happened to jostle him he turned and punched my head. Of course, I had to punch back, and we were both arrested and locked up. One of my customers bailed me out, and, rushing to the hotel, I grabbed my satchel and was off for the train. I was within a block of the depot when I'——

"When you fell over a dog and was delayed, and didn't catch the train," interrupted Dan Hemingray.

"Just so, sir; but how did you know?"

"Oh, I've heard that story told by 15 different men."

"Did they all say it was a bulldog?"

"Every one of them."

"And they were so grateful to him that they bought him a silver collar?"

"Quite true."

"And they presented the man who raised the row on the street with them with $50 in cash?"

"Just $50, sir."

"Then all I've got to say," said Hamilton, "is that the mysteries of life are past finding out."

South Side Electric Railway Situation.

It is said that the Chicago City Railway company does not now fear serious trouble from the General Electric Railway company, which has franchises for the use of a number of important South Side streets, with permission to use the overhead trolley, because of the discovery of contracts with the city, made in 1863 and still in force, which provide that no other railway corporation shall construct lines in Michigan avenue, Wabash avenue north of Thirty-ninth street, Third avenue (now Plymouth place), and other specified streets, without the consent of the City Railway company. The main line of the General Electric road, according to the intention of its promoters and the provision of the franchise, is to be in Wabash avenue, south of Twenty-second street, and one of the two northern termini was to extend from Fourteenth street to Jackson boulevard in Plymouth place. Acting on the discovery, the Chicago City Railway company has filed a bill in the United States Court for an injunction restraining the General Electric Railway company from building lines in Wabash avenue north of Thirty-ninth street and in Plymouth place.

But in the defense of the General Electric Railway company to the suit of Charles Austin Bates asking for a receiver it is averred that the Chicago City people still regard the new company as possibly a formidable rival. The answer was filed in the Federal Court by the General Electric Railway company on Wednesday to refute the complaint of Mr. Bates, charging Perry A. Hull, Edward J. Judd, Lucius Clark and others with an attempt to wreck the road, and asking for a receiver. The 20,000 shares of stock alleged to be withheld from Bates and Brandenburg are asserted to have been given to Clark to sell; that after the sale money and notes were given to Bates, the latter resigned from the directory. The answer accuses the Chicago City Railway company of being behind the prosecution and alleged persecution of the General Electric in order to get rid of a prospective formidable rival. A letter is quoted purporting to have been sent by Judge McConnell, attorney for Bates and Brandenburg, to Gen. G. M. Dodge of the Love Traction company, in which it is suggested that "a community of interests might suggest to you a policy of negotiation." It is also charged that a similar letter was sent to Widener and Elkins of Philadelphia.

Breaking Strain of Trolley Wire.

[From the Electrical Review, London.]

We believe it is a general stipulation in American tramway specifications that the trolley wire should stand a breaking strain of 30 tons per square inch. To some extent consulting engineers in this country are insisting upon a similar strength; but it is questionable, not only whether 30 tons is necessary, but whether that figure is ever obtained in ordinary practice. From some recent tests carried out on both English and American trolley wires, it would appear that the average test is about 23 tons per square inch, as will be seen from the following:

ENGLISH WIRE.

	Tons per square inch.
Sample A.....No. 0	23.4
Sample B.....No. 0	23.9
Sample C.....No. 0	23.9
Sample D.....No. 0	24.07

AMERICAN WIRE.

Sample A.....No. 0	20.2
Sample B.....No. 0	23.4
Sample C.....No. 0000	21.1

It would, at any rate, appear that some of the American wire sent to this country is a long way short of 30 tons per square inch, though it would no doubt withstand all the strains that are likely to be put upon it in practice.

Rubber Covered Wire Trust.

[From the Wall Street Journal.]

We understand that the members of the rubber-covered wire combination are in daily session in this city with a view of arranging details of the agreement of wire concerns which not only cover the wire, but which manufacture the wire which they cover. It is understood that this matter will be disposed of by a contract taking from these concerns their output of uninsulated wire, in consideration of an agreement on their part to stop the manufacture of the insulated wire.

Sprague System of Train Control in Operation.

An Alley "L" train of cars electrically equipped with the Sprague system of controlling motors on each car from any point on the train is now being tested on the Metropolitan elevated tracks and the Union Loop in Chicago. On the first trip an air-brake coupling burst, but Mr. Sprague was enabled to operate the train from another car, and the first trial was declared to be a success. A 10-day trial of the system under working conditions will be given on the Metropolitan road.

Portable Milli-ammeter for Alternating Current Circuits.

The Western Electrician is in receipt of a communication from the Keystone Electrical Instrument company of Philadelphia, in which it announces the new instrument named above. The company states that something over a year ago it received a request from the committee on meters of the American Electro-therapeutic association to design and submit for test a portable milli-ammeter for use on the sinusoidal alternating and faradic current circuits. The solution of the voltmeter problem was quite simple and the requirements were fully met by the Keystone portable voltmeter for direct and alternating current circuits, but the design of a portable milli-ammeter for this class of work presented a novel problem which had never been successfully solved. After several months' careful experimenting the company succeeded in perfecting an instrument which practical tests proved to be satisfactory. The report of the committee on meters presented at the annual convention of the American Electro-therapeutic association, held in Harrisburg last September, contained an unqualified approval of this instrument, and, as a result of the tests and investigation, recommended them to the profession.

In the course of the experimental work a number of tests were made with the milli-ammeter, and some data obtained on commercial apparatus which heretofore had only been obtainable by calculations. Among other things tested was the current consumption in the primary coils of transformers when the secondary was on open circuit, thus determining directly and without calculation the idle losses in the transformer system. The result of the test showed the very great difference in what might be termed the idle efficiency of transformers of various makes, and further showed a marked difference between new transformers and transformers in which the iron had aged as the result of several years' continuous use.

This whole question is one of more than passing interest to central station managers who employ the alternating current, and careful tests of the amount of current required to energize the primary coils of transformers when the secondary is in open circuit would, no doubt, lead to a more careful selection of transformers and the replacing of many which have outlived their usefulness. Direct reading in such matters is far superior to calculation, and no doubt many stations would discover unexpected losses by making a series of tests on the transformers now on their lines.

The instrument itself is neatly designed and mounted on a polished mahogany case; its calibration is carefully made, and it is said that its indications may be relied upon as perfectly correct.

Discipline of Employes.[1]

BY GEORGE H. DAVIS.

SYNOPSIS.

1. Introduction and Definition of Railway Discipline.
2. Principles of Discipline.
   - (a) Confidence of Employes.
   - (b) Fair Dealing.
   - (c) Organization and Classification.
   - (d) Issuance of Orders.
   - (e) Employment to Full Capacity.
   - (f) Vigilance.
3. Civil Service Offered as a Suggestion and Partial Solution of Questions of Discipline in Railway Operation.
4. Civil Service Methods as Employed by the Government.
5. What Features a Successful Civil Service Method Should Include.
6. General Questions of Employment and Promotion, According to Civil Service Methods.
7. Civil Service Methods Employed by the Canal and Claiborne Railroad company.
   - (a) System of Marking.
   - (b) Principles of Same.
8. Application of Civil Service Methods to Large Railway Systems.
9. Results of Competitive Civil Service.
10. Conclusion.

Discipline is universally recognized as a necessity in every important industrial undertaking. It is as thoroughly essential to success in the operation of railways as are the plans and specifications in their construction. In the broad sense it means the government of operatives through whom the equipment is made to do its work, and the efficiency of the equipment varies in direct ratio with the efficiency of its operatives.

A road has good discipline when all employes respect and kindly regard each other; when the officers do their best for the men, and vice versa; and when both officers and men sacrifice everything to the interests of the company.

It is a somewhat difficult task to maintain the conditions as defined, but the nearer this standard is approached the greater the surplus earnings.

Discipline should never be interpreted in the narrow sense that a man is to work as a machine. It is true that "cars should run like clock-work," but to arrive at this result through the constantly changing circumstances that arise requires the services of men of thorough training, presence of mind and good judgment.

There is no fixed method of maintaining good discipline. It is frequently the result of the natural personal characteristics of the man in charge. There are, however, certain principles which are probably of universal application. First of all, a railway manager must gain the implicit confidence of his officers and men. To do this he must, in general, know the details of the design, construction, operation and maintenance of railways. He must have a universal reputation among his men of being shrewd, vigilant, industrious, honest and perfectly fair in his dealings. He must know them all personally, stand by them, and respect them as gentlemen upon all occasions. He must be thoroughly popular and able to create among them a spirit of loyalty and enthusiasm in regard to the road and its interests.

A thing of greatest assistance in discipline is complete organization. Every man engaged in railway operation, from president to track-greaser, should have before him, in printed form, a full synopsis outlining all the essential features, the exact limit, scope and character of service that he is to render.

All officers should have their exact relative rank in the service, which should be thoroughly known among all employes. In this way, if conflicting oral orders are given, the order given by the officer of superior rank will be obeyed without question.

Another feature of discipline is the issuance of orders. Many failures to obey orders are due to a misunderstanding or misinterpretation. It is, therefore, important in railway operation to issue all orders in printed form, clearly and definitely stated. These orders should be sent in explanatory personal letters to all superintendents, foremen, inspectors and starters, and be published on conspicuous bulletin boards at all stations. An order should never be issued except that it meets with the approval of the best officers and men, and, after once issued, it should be an infallible law, applicable to all employes alike, and, if broken, it should in all cases be followed by a prompt and severe penalty.

Satisfactory discipline cannot be maintained unless employes in all ranks are worked to their full, natural capacity and physical strength. Idleness and easy positions in railway operation will undermine the best system of government that could be established.

Again, constant watching is a most important factor. The general manager, or whoever is responsible for the receipts, expenses, maintenance and discipline, should spend at least eight hours a day directly on the lines of the company. There should be trusted starters at both ends of all lines at all times and at least one inspector for each 30 cars operated.

Written reports for the smallest details of both good and bad features of the service should be insisted upon from all officers of the company, and a false report or statement from any employe should be sufficient cause for his immediate discharge. Nothing good or bad in a man's service should be passed without the manager's recognition. One of the strongest incentives to good work among men who are trying to do their best is praise. When a motorman saves a pedestrian from mutilation or death from an electric car, his act should be recognized by a complimentary personal letter thanking him for his skillful work. In general, a manager should have only praise for his officers, and among the men 90 per cent. of them should be above censure. However, when a man is censured it should be severe and the final preliminary to his discharge. A man should never be discharged except his case is given a thorough investigation, and he is given abundant opportunity for defense. When he is once discharged he should never be reinstated.

Railway employes, as a rule, admire a policy which is open, fair and generous. When an unusually large day's work is done in handling a great crowd of passengers, it is no more than fair for the company to share its profits with the men in giving them a few hours' extra time, the number of hours being in proportion to the extra receipts. The amount of money thus invested will in the future return to the coffers of the company a hundred-fold and more.

Perfect management is something beyond human effort; still, if the problem is earnestly and industriously studied, railways may be operated to the complete satisfaction of the public, the stockholders and the employes.

As a partial solution of the different questions arising in connection with discipline, a competitive civil service system is offered as a suggestion. There are no new principles in this sysem as commonly understood. It is only a way of carrying out what every successful man has always followed in his business career. He selects the man whom he believes most efficient; he promotes the man who is of the greatest service to him, and discharges the man whose services are of the least value.

All civil-service methods employed by the government take account only of a man's ability in successfully passing the initial competitive examination. In reality a man's work in the service after employment should have far greater weight in regard to his retention or promotion than the mere fact that he was able to answer correctly a series

1. Read before the American Street Railway association, Niagara Falls, N. Y., October 22, 1897.

of questions, at best having only an auxiliary connection with the work to be performed. Another serious weakness in municipal or government civil-service methods is that often questions are prepared and answers examined by commissioners who know nothing of the business, trade or profession for which they are conducting the examination. In all cases questions should be prepared and examinations conducted by the head of the department under whom the candidate is to work after entering the service. To insure perfect fairness, commissioners may be delegated to criticise the questions, witness the examinations and judge of the relative merits of all answers. Any successful competitive civil service system for railways must take into account:

1. The previous history of the applicant, including his railway experience.
2. His knowlege and skill in railway operation, which is covered by competitive examination.
3. His physical condition.
4. The quality of his work after entering the service.

The quality of his work after entering the service is the best criterion by which to judge of his relative value. However, before a man is employed it is impossible to judge of his work, and the only alternative is a broad, practical, competitive examination, which covers a sample of his work under the observation of the examiner, together with answers to the most practical questions that may be framed.

In applying these methods to railway operation and maintenance, it is necessary, so far as practicable, to classify the positions of each of the departments, so that there is a fixed line of promotion from the lowest to the highest rank. This does not mean that a man shall have worked in all ranks of a given branch of the service, or even in all branches of a given department. It does mean, however, that he shall have started at the lowest round of the ladder in some one branch and have learned some one department to perfection and all departments in general. Railway companies vary widely in their classification of positions and the relative importance which they attach to the services of each department. It is not intended at this point to discuss the organization of railway operatives.

A classification so far as civil service methods are concerned may be compared to a river and its tributaries, where the waters of all branches, if they are not evaporated, may reach the desired terminal. In short, it is a question of all being given an opportunity, and the survival of the fittest.

There are, apparently, some difficult features in the general policy of promoting men according to their relative standing, from one department to another, or even from one branch to another of the same department. The skill and experience required in one may be totally different from that required in another, and again, a man may show marked ability in one position, while in another he would prove most inefficient. However, if a man is industrious, bright and faithful in one position, he will maintain the same characteristics in another, and, as every practical man knows, these qualities of character in an employe are more desirable than all others.

A competitive civil service system if correctly applied is a most advantageous solution of the question of advancement of employes, and does not interfere with a practical line of promotion. For example, if a vacancy occurs at the head of a given department, all employes ranking highest in the various branches are eligible to compete for the position. In deciding upon the successful candidate, two things should be taken into consideration—the previous standing and record of the competitors with the company, and the result of their competitive examination.

In all departments of the Canal and Claiborne Railroad company employes are placed upon a basis of competition. Men are employed who have the best standing according to a broad, competitive examination, and are placed in the lowest rank of any given branch of the service.

Promotions in the several branches, so far as practicable, are made consecutively from one rank to another. The company fills every position from among its own employes, provided there is anyone in the service competent to take the place. To illustrate, if the position of chief dispatcher were vacant, all starters employed by the company would be eligible to compete for the position. The chief dispatcher prepares all schedules, knows the exact position of every car on the road and the crew that is operating it. Now, if, upon competitive examination, it was found that no starter employed by the company was able to prepare a thoroughly practical, satisfactory and economical schedule, then no one in the direct line of promotion would be given the position. In this case another examination would be held in which the employes of all departments would be eligible, together with the employes of other companies or outside persons. In this way merit alone is recognized as a basis for advancement, and also the highest standard of efficiency is maintained in the various positions.

So far as practicable the same regulations apply to the transportation department, the maintenance department and the accounting department.

In the transportation department, in the employment of motormen and conductors, when an applicant presents himself, if he is worthy of consideration after a preliminary conversation and inspection, he is given application and recommendation blanks.

To be eligible for appointment as motorman or conductor, the applicant must be between the ages of 25 and 40, for the position of motorman he must weigh at least 160 pounds and not exceed 210, and must be at least five feet eight inches in height; he must have had at least one year's experience in the position he seeks, and should be recommended to the service by at least three officers of the company, including foremen, inspectors and starters, and also by at least seven motormen and conductors who are already in the service. He then obtains the company's physician's certificate with regard to his physical condition. If his certificate, application and recommendations fill the requirements and are apparently satisfactory, they are then given to an inspector who personally investigates his previous record among the employes with whom the applicant has worked, and also among outside persons who know the applicant. If the inspector's report of investigation is satisfactory, the applicant is placed on the lines of the company with motormen and conductors who have the best standing in the service. He rides with these men until he is familiar with the special features of the lines of the company. He is then given the competitive examination. This is intended to be extremely practical and consists of two parts:

First—The applicant takes charge of a car with an inspector who estimates the quality of his work for one trip over each line of the road.

Second—He answers a list of questions covering the various things connected with this department of railway service.

Finally, the applicant presents himself at the office of the general manager, where he is questioned in regard to all orders and instructions previously issued by the company, and his understanding of the conditions under which he will be expected to work.

Based upon the foregoing, applicants having the highest standing are given the positions as extra motormen and conductors as fast as vacancies occur.

If inexperienced men are employed at all in the service, they are taken on as conductors and kept in this position for at least six months, and for three months they work without pay. After this work as conductors they break in as motormen with motormen already in the service who have the highest standing. After six months' service of this kind, they are given their examination and are placed on the lines of the company as extra motormen.

To determine the relative standing of employes a system of marking has been adopted, which takes into account:

First—The general quality of a man's work, according to the judgment of the foreman in charge.

Second—The value of the special acts in his service as reported by foremen and marked in the record of the employe according to a fixed scale kept in the main office.

To illustrate, in the department of transportation for motormen and conductors blanks are prepared which contain the names and numbers of every motorman and conductor in the service. At the head of these blanks there is a personal letter addressed to the general manager, which is as follows:

"According to my best judgment the quality of service rendered by each employe coming under my observation in my department of the service, being fairly and honestly estimated for to-day, is as follows:"

Opposite the name of the motorman or conductor there is a blank space left for the mark of the foreman. Each foreman, inspector and starter has one of these blanks, and marks after the conductor's or motorman's name the quality of his work for the day, and sends the blank to the main office the next morning. He marks "v e" for very excellent, "e" for excellent, "g" for good, "f" for fair, "p" for poor, and "v p" for very poor.

In the main office these marks are reduced to an arithmetical basis and placed in the record of the employes. In determining the marks to be placed in the record, the marks of all foremen, inspectors and starters for a given man are added and the mean taken, which is considered the final mark. In this way the average judgment of perhaps 10 different foremen in regard to an employe's work is obtained.

The marking of the special acts of an employe is on a more definite basis, and has no connection with the judgment of the foremen, inspectors and starters. They simply report the acts. Based upon bulletins, instructions or orders issued, and also upon experience in good railway practice, two lists of acts of employes are made, one delineating all the desirable or commendable features of the service of an employe, the other all the undesirable or intolerable features. For each of the acts in the commendable list, a certain number of points of merit are always given. Similarly, for each of the acts in the uncommendable or intolerable list a certain number of points of demerit are given. To illustrate more thoroughly, a few of the acts mentioned in the merit and demerit list may be given. In the merit list for motormen we have: Skillfully avoiding accidents; assistance on minor road repairs; suggestions as to best speed of cars; helping to clear blockades; assistance rendered on special occasions; obtaining names in accident cases, etc., etc.

In the demerit list for motormen we have: Running with hands off of brake and controller; looking around while car is in motion; not running on schedule time; feeding car too fast; untidy condition of dress; accidents to persons (serious, medium, slight injury); accidents to cars (serious, medium, slight injury); accidents to vehicles (serious, medium, slight injury).

In the merit list for conductors we have: Complete and perfect accident reports; reports as to where the company is gaining or losing traffic; reports as to what passengers say; kindness to aged and infirm persons; assistance rendered on special occasions; obtaining names of witnesses in accident cases, etc., etc.

In the demerit list for conductors we have: Incomplete accident reports; insufficient number of names in accident cases; no change; not announcing route, streets and transfer points; leaning against door conversing with passengers inside; short register; bunching fares; ringing up fares when officer boards car; register not turned; shorts and overs; untidy condition of dress, etc., etc.

The marking for general daily reports, together with reports of special acts, is kept in a record book, which allows four pages to each employe, each of the pages being numbered to correspond with the employe's badge number. The first two pages of each employe's record are made up in blank form, allowing space for each day of the month, together with each month of the year. The next two pages are plain ruled, and are used for explanations of each mark given.

The margin of the first page is divided into blank form, giving the information regarding an employe, which is usually covered by headings placed in application blanks. Each month the points of merit and demerit are balanced. If an employe's record falls below zero, he is discharged.

The estimation of the value of a man's services, according to the above method, is based upon two foundation principles, one being a check upon the other. Every officer of the company has his own ideal, and, due to the fact that every human being sees the world from a different standpoint from every other human being, the chances are that with an employe's work estimated upon by 10 thoroughly experienced railway operatives, the average judgment of these men should be correct. Acting upon this principle, favoritism among officers is almost completely eliminated. Some men might be favorites with two or three officers, due to outside circumstances, but this would never extend to the whole 10, or even five. A car operative's life is not filled with opportunities to render brilliant services in behalf of the company, and, for this reason, some method of estimating his work must be adopted which will give credit for every day's efficient, satisfactory conduct. The method employed has proven by experience to be simple, just and effective.

The second principle used in the estimation of the quality of the service is embodied in the fact that a more just and unbiased decision can be reached in regard to the merit or demerit of an act, if judgment has already been passed on an exactly similar case. Now, by the system of marking mentioned, a list of all possible cases is prepared, and judgment passed upon by them by the general officers of the company, the relative number of points of merit and demerit being fixed. Now, when an act occurs, it only remains to locate it in the list to pass judgment. Hasty or snap judgment passed in a fit of anger on an employe's offense usually results in the greatest injustice to the employe. The reaction among employes is such as to practically destroy their confidence in the company and always proves detrimental to the best interests of the road.

Promotions among motormen and conductors are always made according to their standing, as determined by their records, without examination. The "extra" motorman or conductor having the best record is promoted to a "swing" run. Similarly, the "swing" men to "half-and-half" and the "half-and-half" men to "straight day" runs. Straight-day motormen and conductors are promoted to the positions of inspectors, starters and transfer agents on their records alone. No account whatever is taken of the relative data at which the employe entered the service.

As mentioned before, the same general methods are employed in all departments, but, owing to the fact that the transportation department is the most important of all, the details of the civil service system are carried out most thoroughly in this connection.

To insure perfect accuracy and fairness each employe is invited to examine his own record or that of any other employe at any time. He is also at liberty to inspect the scale of marking by which the records are adjusted.

It is evident that a system of bookkeeping resulting from the methods as described would be more expensive to maintain than other forms of discipline which have been generally employed. It has been found, however, that the extra expense attached to this system is trifling in comparison with the results obtained.

The larger a street railway the more thoroughly applicable are civil-service methods. This comes from the fact that on small roads the general officers of the company come more in contact with the employes, thus being able to judge personally of the quality of their service, regardless of records kept, and, too, on small roads the same employe may fill several positions, in comparison with a

thoroughly classified organization which must be maintained in large street railway systems.

Regarding the general results of a thoroughly enforced competitive system, it may be stated that there is as much difference in the quality of work rendered by men engaged by a road operated on a competitive basis of promotion, and a road on which promotion is made according to the position of a man's name on the list, as there is between two railway companies, one having a monopoly of the traffic and the other having a direct paralleling competitor. It has been found by experience in the operations of roads where employes work on a competitive basis that they invariably do their best. They are gentlemanly in their treatment of passengers, neat and tidy in their dress, and skillful and prompt in the discharge of their duties. They take great pride in the company's fine equipment, its large business, its management and principles of fair dealing. They never fail to praise the company and its service to patrons, and are only too glad to answer, in behalf of the company, any adverse criticism offered by patrons or the public. They feel from the start that their present and future positions in the railway business depend upon the quality of their work, and nothing else.

Legitimate competition is one of the most powerful incentives that can be employed. Men under these conditions are forced to make their best efforts. This is illustrated constantly in all professional, mercantile and manufacturing industries. The piece-work system in vogue in New England factories is only one method of competition, by which a man is paid according to the quality and quantity of his work.

On a competitive basis the standard of excellence is constantly being raised. When a large number of men are engaged in the same kind of work, there are always a few who will accomplish most extraordinary results, and their work stands as a most effective object-lesson to the others. If a man has anything in him, competition will bring it out; if he has no redeeming features, then his services are not required.

Another advantage of the civil-service system is that it effectually debars all outside influence and eliminates the bugbear commonly designated among the men as a "pull." It also completely obliterates political interference, which is the greatest bane to the efficient services of American street railways.

In conclusion, it may be stated that this system is not urged as a panacea for the ills of railway management, but is merely offered as a suggestion, with the hope that it may be of some slight assistance in improving the successful methods which have always been employed.

CORRESPONDENCE.

New York Notes.

New York, November 15.—The favorable report of the Supreme Court commissioners on the plan of the Rapid Transit Board will come up for confirmation before the Appellate Division of the Supreme Court on Monday next. The Sun and the Brooklyn Eagle are opposing the project, but President Orr of the Board of Rapid Transit Commissioners says that the testimony in favor of the tunnel route was so overwhelming that he does not see how the court can fail to approve the report. Mr. Orr told a reporter that if the decision of the court were favorable the Rapid Transit Board would soon advertise for bids. The advertisements will have to run three weeks, and at least one satisfactory bid is hoped for. It may be that the first contract will be awarded before the year is closed.

The Brooklyn bridge trustees have been temporarily enjoined from prosecuting the work of laying the loop trolley car tracks across the passageway at the New York terminus of the bridge. The injunction was granted by Justice Giegerich of the Supreme Court on Friady night, and copies of it were served on President William Berri, Comptroller Fitch, who is ex-officio a member of the board, and Superintendent C. C. Martin of the bridge. The complaint sets forth that the trolley tracks across the passageway are a menace to public life and health. Comptroller Fitch says that the trustees have a good defense, and thinks the injunction will be vacated when their side is heard. "I understand," he said, "that the plan which was adopted was the most feasible one which competent engineers could devise, and it is, they say, a safe plan." Superintendent Martin said that the plan was a perfectly feasible one and could not be better. "The danger to pedestrians crossing the trolley loops is comparatively slight," he said, "when the dangers they ordinarily incur are considered. In all the improvements on the bridge the trustees have always taken the safety of the public into consideration the first thing, and I think they have done so in this case."

The recent decision of the Court of Appeals in the Kingston case, that the tracks of a railroad company cannot be used by another company, may prevent the running of trolley cars and elevated railroad trains across the Brooklyn Bridge. President Berri of the bridge trustees said: "If the decision of the Court of Appeals forbids the cars of all the trolley companies coming to the bridge by way of Washington street and leaving the bridge by way of Fulton street, the entire bridge-crossing project is endangered. It would appear that the Brooklyn Heights road is the only trolley company that would have access to both roadways, and thus could make connections to both reach and leave the bridge. The other companies have no possible means of connection with the south roadway or the one by which they are to leave the bridge, although they could reach the bridge at the north roadway at Washington street. The policy of the board has always been that the privilege of crossing the bridge should not be confined to any one company or system, either trolley or elevated, and I am convinced that if it should turn out that the Kingston decision prevents any one of the companies from reaching and leaving the bridge, the trustees would revoke the privilege of all, including the elevated railroads."

The relations between the Electrical Contractors' association of this city and the Brotherhood of Electrical Workers have now reached a crisis. Early this year the brotherhood informed the association that on January 1, 1898, it would demand an increase of wages from $3 a day to $4 a day. The brotherhood was notified by the association that the demand would be denied, as the conditions of business would not justify such an increase, nor did the association regard the work required as sufficiently skilled to call for so high a rate of wages. The question has since then been a subject of continuous negotiation, neither side showing any disposition to recede from the position taken. Other cases of irritation have also arisen. One in particular has called forth much protest from the employers. This is the alleged refusal of the journeymen to admit into their union a sufficient number of men to supply the demand in this city and vicinity. The association has sent to the brotherhood an ultimatum. In part it says: "Our members have not yet engaged non-union employes, but if by reason of your own action they cannot secure competent union help, they will have no alternative but to do so. They do not wish to do it without notice to you, which will give the opportunity of remedying the difficulty, and, therefore, at the meeting of this association held November 9, 1897, it was resolved that your union be notified of this complaint, and requested to promptly remove the trouble by such effective action as the situation seems to call for. Failing to receive due notice from you of such effective action by Monday, November 15, 1897, you are informed that the members of this association will be compelled, in order to carry out their contracts to the satisfaction of their customers, to call to their assistance the services of such workmen as they may need, without requiring that they shall be members of the union." Although it was stated in the communication that the intention therein expressed would be carried out to-day, if the conditions insisted upon were not complied with, the committee later decided not to make the ultimatum operative until Wednesday. Apparently the workmen have no intention of taking any notice of the communication, not in any way having acknowledged the receipt of it, although it was sent by registered mail four days ago.

M. S.

Northwestern Notations.

Minneapolis, November 16.—The receiver of the street car line at St. Cloud, Minn., has been authorized by the bondholders to expend $3,500 in new motors, new poles and rebonding the rails. The owners have declined two offers for the system and consider it a good property. It is now earning more than operating expenses.

The Eau Claire (Wis.) Light and Power company has been permanently organized. The company has expended considerable money since the reorganization in improvements and will make others. The steam plant will be enlarged and the water power improved.

It is said that the dynamo for the new electric light plant at Valley City, N. D., will have to be replaced by a larger one before spring, as the present one is carrying all that it can, and there is considerable demand for light that cannot be met.

The Business Men's association of Green Bay, Wis., wants telegraph tolls reduced, and will appeal to the Postal and Western Union companies to grant a reduction.

The Sheboygan Electric Railway company has a franchise for an electric car line to Sheboygan Falls, Wis., and will construct the line in time.

It is understood that R. C. Libbey of the Britton, S. D., mills contemplates putting in an electric light plant to furnish light for the town.

The Fergus Casket company of Fergus Falls, Minn., contemplates putting in a plant to furnish light for its factory.

The Chippewa Valley Electric Railway company has selected a right-of-way for the interurban line to Chippewa Falls, Wis., from Eau Claire. The iron is arriving, and construction will be begun in the early spring.

The Oshkosh, Wis., City Council, has granted a franchise to the Citizens' Traction company in place of that held by the Oshkosh Street Railway company. It requires the company to use iron trolley poles on the main streets.

C. Burkhardt has bought the interest of his partner in the electric light plant in Hudson, Wis., for a consideration of about $30,000. Mr. Burkhardt now owns the entire plant.

The General Electric company of Des Moines, Ia., has filed a notice with the City Council that it will not accept the new ordinance rates, citing the constitution of the United States to support its position. The company contends that the city is taking its property without due process of law. The communication means a fight in the Federal Court if the ordinance is not repealed or modified.

The Monitor Electric company of Minneapolis has filed articles of incorporation with the secretary of state. The capital stock is $100,000. The incorporators are A. D. Arundel, S. N. Smith, T. B. Hatch and T. C. Shove.

George R. Folds, who has been prominently associated with the Twin City Rapid Transit company in Minneapolis for the last five years, was offered the position of claim agent for the Nassau Electric Railroad company of Greater New York, but refused it.

C.

PERSONAL.

J. O. Crane of Holmes, Booth & Haydens, New York and Waterbury, Conn., visited Chicago last week.

Among last week's visitors in Chicago was J. H. Mason, general manager of the Simplex Electrical company of Boston.

Manager Henry A. Coit of the Missouri Telephone Manufacturing company of St. Louis visited Chicago on Wednesday. Mr. Coit returned to St. Louis the same evening.

W. D. Packard, secretary and treasurer of the New York and Ohio company, of Warren, O., passed several days in Chicago last week before returning to his home from the East.

A. W. Kilbourne, general sales agent of the Ohio Storage Battery company of Cleveland, O., visited Chicago last week. From Chicago Mr. Kilbourne went to St. Louis, thence he will go to Indianapolis, Cincinnati and Pittsburg, where he proposes establishing agencies.

J. F. Gray is again connected with the Chicago Edison company. Mr. Gray was secretary of the electrical engineering staff at the World's Fair, and in that position made many friends by his tact and unfailing courtesy. Afterward he accepted a position with the Chicago Edison company, but later he secured a lakeside farm in Michigan and devoted his energies to fruit raising. Having now disposed of his horticultural interests to advantage, Mr. Gray is once more in the field advancing the interests of his old company.

Mr. Walter G. Whitmore of the General Electric company and Miss K. Marcellus-Buttrick of Bay Ridge, N. Y., were married on October 12th at the home of the bride's parents. Mr. Whitmore is a graduate of the Massachusetts Institute of Technology, whence he went to Chicago and was for some time with the Chicago Edison company. In 1889 he joined the engineering staff of the Edison General Electric company, and, after the consolidation of the interests which became the General Electric company, he was placed in charge of the entire electrical construction work of the New York office of that company, with the title of local engineer. Mr. and Mrs. Whitmore have the best wishes of many friends in the electrical fraternity.

James A. Colby, for nine years manager and treasurer of the Edison Electric Light company of Des Moines, Iowa, and more recently manager of the consolidated electric companies of that city, has gone to Schenectady, N. Y., the headquarters of the General Electric company, to assume the duties of a more responsible position with the latter company. Mr. Colby, in his business intercourse with the people of Des Moines, has won their esteem and high regard for fairness and affability, and the Iowa State Register says that in leaving the city he will be followed to the distant field of his future labors by the hearty good wishes of everyone who was favored to know him in the years he has been associated with the Edison company in Des Moines.

John Conover Hinchman of Summit, N. J., died in the Orange Memorial Hospital at Orange on November 13th, after a lingering illness. Mr. Hinchman was born in 1820 near Hackettstown, and was educated at Lafayette College. He became interested in telegraphy, and for a number of years he was associated with the Western Union Telegraph company. In 1875 he was promoted, on the death of George H. Mumford, to the place of superintendent of the eastern division, embracing the New England states and the British provinces. On reorganization of the company in 1881, under General Eckert, Mr. Hinchman resigned, but later accepted another place and was connected with the company at the time of his death. Mr. Hinchman removed to Summit with his family from Brooklyn in 1865, and had lived there ever since, spending his summers at his place in the Adirondacks. He leaves a widow and two grown daughters.

ELECTRIC LIGHTING.

A Chinese syndicate has been formed for introducing electric light in Hang-Chow Fu, the capital of Chi-Kiang, and in the town of Han-Kau, on

the Yang-tse-Kiang. An electric light plant is supplying current for private lighting in Chang-sha-Fu, in the anti-European province of Hunan.

ELECTRIC RAILWAYS.

The right-of-way for an electric road between Flint and Pontiac, Mich., has been secured. Joseph Sawyer of Pontiac and George E. Taylor of Flint are among the promoters.

The Hamilton, Venice and Okena Electric Street Railroad company has filed articles of incorporation, the incorporators including O. V. Davis, W. C. Shepherd and E. Mueller. The capital stock is $10,000, and the headquarters will be at Hamilton, O.

The Central Passenger Railway company of Baltimore has installed in its power house a storage battery plant of 265 cells having a capacity of 1,000 ampere-hours. It is said that the battery could operate the entire system for five hours if all the power house machinery were shut down or disabled by accident.

Charles A. Mann of Bangor, Me., proposes to do away with some of the annoyance of rainy-weather riding on open street cars by building a gutter about the edges of the roof of the car. Hollow hand-rails for passengers, at the sides of the car, are extended to the roof and conduct the water to the ground. The device has been patented.

The Brooklyn Rapid Transit company, which controls the entire Brooklyn Heights trolley system, has purchased the New York and Sea Beach railroad, which will furnish a direct route to Coney Island. The connection between the two roads will be made at Third avenue and Sixty-fifth street. Electric instead of steam power will be used on the Sea Beach line, and traffic will be continued all the year. It is said that the Rapid Transit company may also purchase the Brighton Beach road.

A successful trial was made on the 22d of October of the new electric street railway of Bamberg, Germany. The trial was made before a royal commission of experts from Munich, Nuremberg and Bayreuth, and the performance of the cars under difficult conditions, up steep grades and around sharp curves, evoked the hearty approval of the judges. A particular feature of the trial was the application of the electric brake, which seems to be popular abroad. The cars are equipped throughout by the Walker company of Cleveland, O.

A lease for 999 years of the Coney Island and Gravesend Railway company to the Nassau Electric Railroad company of Brooklyn was filed with the secretary of state at Albany on November 12th. Part of the Gravesend company's lines are yet to be constructed, but the lease covers all. The consideration named is that the Nassau company shall pay the costs of construction and all taxes and assessments on the Gravesend lines, and also the sum of $150,000 in cash, with five per cent. interest, within the next five years or at the expiration of that period. The lease is signed by P. H. Flynn, president, and Fred. C. Cocheu, secretary of the Coney Island and Gravesend Railway company, and by A. L. Johnson, president, and W. F. Ham, secretary of the Nassau Electric Railroad company.

The Railway Review notes that Henry George's plan of free street railway service is said to have worked well at Sidney, New South Wales, where the city owns the lines, and runs them without charging fares. It is stated that the people do not use them any more than they did before they were free, and that the expense of maintenance is cheerfully borne by the taxpayers. The only places in the United States where the public enjoys free transportation, so far as can be ascertained, are Oakland, Cal., and Havre de Grace, Md. When the Central Pacific Railway company was seeking right-of-way into Oakland it was granted by the Common Council upon the condition that the suburban trains should carry all citizens free within the city limits. The bridge across the Susquehanna at Havre de Grace belonged to the county, and when the Philadelphia, Wilmington and Baltimore company was seeking the privilege of crossing it many years ago the entire property was turned over to that corporation upon the agreement that it should be maintained perpetually as a free bridge and that no fares should be charged for crossing, either for foot pedestrians or passengers upon the trains.

There are some Londoners who think that the streets of that town are none too good for the overhead trolley wires, so that much-needed improvement in transportation facilities may be secured. Thus a corespondent of the Pall Mall Gazette says: "Two years have elapsed since a long letter which I have before me appeared in your paper advocating the employment of electricity for propelling tramcars in London. The writer then asked, 'Why does London wait?' and if he still lives he may repeat to himself the question, and soliloquize upon the lack of energy which pervades the metropolis. Every week now one reads of large towns, such as Manchester, Leeds and Sheffield, making the fullest inquiry into various electric systems; and is it too much to expect that London, with her enormous number of daily travelers, should not be the last to offer them quicker transport, lower fares and more comfortable and better lighted vehicles? The objectors to prompt action urge in defense that some improved system may yet be discovered! Or that the appearance of overhead wires would be most disfiguring! If we always follow the first principle, and wait for something better to turn up, the march of progress will be indeed slow. Further, when convenience and appearance are placed side by side and only one can be enjoyed, the nation of 'shopkeepers' should choose the former. It would be well for those who oppose the system, which involves the use of one wire down the center of each car track, to visit Queen Victoria street and see overhead the thousands of wires crossing, yet not disturbing the minds of those who come or go on business beneath. No, sir, the question of telephones, mere luxuries, may well be relegated to the future, but the operation of tramways in London is a matter for present and decisive action."

TELEPHONE.

The Vermont Telephone and Telegraph company has sold its entire system of wire and instruments, extending over five counties, to the New England Telephone and Telegraph company, for about $50,000.

ELECTRICAL SECURITIES.

Last year the third quarterly report of the Syracuse Rapid Transit company recorded a deficit of $7,961 in the business of that period. This year the company's net income is $16,650 after paying fixed charges and all operating expenses. Its receipts were more than double those of the corresponding quarter of last year.

The Buffalo Railway company's report for last quarter is extremely satisfactory. After providing for operating expenses and fixed charges it showed a surplus of $100,179, an increase of $15,367 over last year's corresponding quarter. The Crosstown Street Railway company of Buffalo, on the other hand, reports a decrease of $3,598 in the same time.

There was a considerable falling off in the gross earnings of the Brooklyn City and Newtown Railroad company during the quarter ended September 30th, but as the expenses were cut down considerably, the net income was almost the same as a year ago. The company's operating expenses were $65,380 and its fixed charges $32,492, leaving net income $18,410.

Increase in earnings and decrease in operating expenses and fixed charges contribute to an improvement amounting to $117,358 in the financial condition of the Metropolitan Street Railway company of New York for the quarter ended September 30th. The gross earnings were $2,217,942, operating expenses $1,214,351, other income $164,385, fixed charges $783,791, leaving a surplus of $384,185. The general balance sheet shows cash on hand $6,093,704 and a profit and loss surplus of $1,277,899.

Sixty was bid for a Lake Street "L" first-mortgage bond on the Chicago Stock Exchange last Wednesday. The fact that the bid failed to bring a reply of any kind may be taken as an indication that the holders of the first-mortgage bonds of the road feel strong in their belief that the court will uphold them in their opposition to the reorganization agreement by which the assenting bonds were scaled 40 per cent., receiving in lieu of the 40 per cent. shaved off their holdings 15 per cent. in income scrip. It shows that the holders of the first-mortgage bonds regard them as good and free securities, representing a first mortgage on the Lake Street "L" property for the amount of their full face value, and not as certificates which entitle them to 75 per cent. of the face value in debentures and income bonds. If the holders of the first-mortgage bonds had the least idea that the court would eventually uphold the Lake Street reorganization plan as applying to their bonds, there is little doubt that they would be only too glad to sell out at 60, for that price for the first-mortgage bond would be equal to 95 for the debenture, which would be issued for 60 per cent. of the mortgage bond's face value, figuring that the income bonds are worth 30, about their present market value, and a value they have rarely exceeded in the market. The debentures which have been issued are now selling at 71.

MISCELLANEOUS.

The Occident Club gave a pleasing musicale in its rooms in the Western Electric company's building on November 13th.

The Chilean Congress, lately in session, passed a law empowering the municipality of Valparaiso to grant for a term of years, not to exceed 30, the use of the streets, roads and squares of the city, for the installation of electric lighting and a system of tramways, with electricity as the motive power.

In 1896 there were imported into the Hawaiian Islands electric and telephone instruments and materials to a total value of $32,492.04. Of this, $13,099.89 represented the value of the goods on which duty was paid when imported, and $19,392.15 the value of the goods entered free. In addition, there were also entered free, under the provisions of the Civil Code, 210 packages of wire for electrical purposes, valued at $731.09; 106 packages of various articles, valued at $4,117.09, and one lot of electric materials, valued at $189.04.

An ingenious device for supporting an incandescent electric lamp upon any part of a machine is on trial at the Topeka shops of the Santa Fe railroad. It consists simply of a couple of magnets attached to the socket of the portable lamp, by which the lamp may be attached to any body of iron or steel.

An electrically propelled "moving sidewalk" is a proposed feature of the Paris Exposition of 1900. As at the World's Fair, there will be two sections. The speeds will be about three and six miles an hour, and the motive power for each section will be distinct. The platforms will be built on an elevated structure.

This item recently appeared in a New York financial paper: "An interest close to General Electric says the operation of the trade pool has terminated costly competition for orders, although each interest is energetic in its search for business. The legal expenses of the company have been reduced fully 80 per cent. as a result of the combination and the settlement or termination of costly patent suits."

By a decree recently promulgated by the government of Guatemala electric batteries, uncharged, for public purposes, are admitted free of duty. Galvanized iron wire and copper wire (insulated) for electrical transmission, electric apparatus (with the exception of certain chemical substances comprised in the tariff) and glass globes for incandescent electric lights pay duties on their gross weight.

In the new plant of the Reading Car Wheel company of Reading, Pa., which was recently started, electric power is used throughout. The molding department is a steel building 94 by 155 feet, and the cupola building connected with it is two stories and 40 by 80 feet. H. H. Hewitt, who is also president of the Union Car company of Depew, N. Y., is president. The vice-president and general superintendent is Richard E. Coleman.

Chief Engineer Daniel Dodson of the electric lighting plant at Sedgwick street and Chicago avenue, Chicago, was cleaning a dynamo a few days ago when he accidentally touched a live wire and received a severe shock. The force of the shock was so great that he was thrown violently against the wall at the opposite side of the engine room, where he lay unconscious for some time, until Assistant Engineer George Steadman returned at eight o'clock from his supper. Dodson was taken to the Polyclinic Hospital, where an examination showed that the two middle fingers of the right hand were broken, his body severely bruised, and that several severe scalp wounds had been sustained. The physicians say that he will recover.

The Rhodin system for the electrolysis of brine and the production of alkali and bleach, which is receiving attention abroad, is of the mercury type, in which that metal acts as a carrier of sodium from the brine, whence it is derived to an external compartment, where it comes into contact with water, producing caustic soda. Whether it acts as a final or an intermediate electrode is not made plain by the descriptions of the apparatus which have been published. There are obvious advantages in the apparatus. The circulation of the mercury is rotatory, and it is a simple matter to heat the contents of the cell should a moderately high temperature be found advantageous for electrolysis. The claim is made that a greater output per unit of plant can be obtained than by any other process.

Consul Bidlake writes the State Department from Barranquilla, Colombia, as follows: "The manager of the electric light plant in this city informs me that the lowest price that he has been offered incandescent lamps in the United States is 18 cents, but that he has had offers from Italy of ordinary lamps of 31 watts at 55 centimes. He also informs me that wire can be bought in Germany at from 10 to 15 per cent. less than in the United States. In writing to me upon electrical apparatus in Colombia, the manager says: 'In the country that you represent the major part of the manufacturers of this class of merchandise are sleeping upon their laurels, waiting for orders to come in through commission firms; they do not study the South American market, so as to become acquainted with the requirements of these countries.'"

The case of Ruppert against the Brooklyn Heights Railroad company, in which a judgment for the plaintiff was recently reversed by the Court of Appeals, illustrates how judges will differ upon the question whether negligence may or may not be inferred from a given state of facts. The complainant's son was driving a wagon which came into contact with a paving stone alleged to have been left in the street by the carelessness of the railroad company. The shock of the collision threw him off his seat to the ground, and he was run over and killed. The main issue was whether the stone was left in the street by the railroad corporation or somebody else. Four judges of the Court of Appeals thought there was not enough

evidence in the case to justify the jury in concluding that the defendant company placed it there, while three of the judges thought otherwise. Thus, the plaintiff recovers nothing for the loss of his son, although seven of the 10 judges who have heard the case in one court or another have agreed that there was sufficient proof to sustain a verdict in his favor; that is to say, the judge who tried the suit with a jury, the three General Term justices who affirmed the judgment in the Supreme Court, and the three judges in the Court of Appeals who dissented from the views of the majority of that tribunal.

The Myers automatic ballot machine was used in the city of Yonkers in the recent election and, according to the New York Times, "it is conceded that in one instance one machine made an error of 200." The possibility of such mistakes would seem to be a grave objection to the continued employment of this method of registering votes. In the matter of Many, which arose in the city of Mount Vernon last year, the Appellate Division of the Supreme Court in the Second Department had occasion to consider the question whether the setting of the dial in the Myers automatic ballot machine at the figure prescribed by the statute before the voting begins is a judicial or an administrative function. In deciding that it was a purely ministerial or administrative duty the court remarked that the facts of the case suggested the possibility, not to say probability, of errors in the operation of ballot machines which might give rise to serious consequences in the future.

Robert Goelet's new Scotch-built yacht, the Nahma, is said to have cost $600,000. The boat is a large one, and a noticeable feature is the extensive and varied use that is made of electricity. Of course, the general lighting of the interior is no novelty at the present day, nor can her powerful electric searchlights be now considered peculiar, but the use of electric sidelights and masthead lights seems to be new among pleasure vessels. These are all adjustable, and are removed each morning. Electric heaters are also seen in some of the living rooms, and in the laundry the women use electrically heated smoothing-irons. In the charthouse there is an invention which tells the moment at which any or all of the sidelights and masthead lights fail to shine out, if this should ever happen at night. And when the extension bell service for the calling of stewards and for the signals of officers is also considered, the Nahma may be said to possess a more complete electrical outfit than any other yacht afloat.

The Massachusetts railroad commissioners lately gave a hearing on the petition of the city of Boston for approval of a plan to sprinkle the streets by use of electric car sprinklers on the tracks of the West End street railroad. Frank D. Perry testified that 75 or 80 feet of surface could be sprinkled by the cars. Superintendent Stone of the Worcester highways, Mayor Ramsdell of Lynn and others testified to the success of electric car sprinklers in those cities. President Little of the West End road and Superintendent J. E. Rugg of the same company opposed the petition on the ground that it would be against the interests of the public, and that the road could not make a contract for street sprinkling, as it was a transportation company. Besides, it would be necessary to make a stop every three-quarters of a mile to fill the sprinkler car, which means 18 stops in sprinkling the distance planned for, with a constant delay to traffic. Mayor Quincy argued that the scope of the street sprinkling now done could be very largely increased at a slight expense by this method, though he admitted that it would probably delay traffic to permit sprinkling at all hours. He also admitted that it would be an innovation to sprinkle so large a city by this method. Chairman Sandford of the commission pointed out that the act, passed this year, permitted the electric road to sprinkle the streets, but that it only permitted the board to approve, not prescribe, the terms of a contract which must be made between the city and company. Mayor Quincy hoped the moral influence of the decision would lead the company to make the contract. The mayor was requested to draw such an order as he felt covered the case, and the board intimated that it would then decide if it could consistently approve it.

TRADE NEWS.

The "Van" gas engine is well esteemed by those capable to judge. The management of Purdue University has placed an order with Van Horne, Burger & Co. of Dayton, O., for one of these engines, to be used in the experimental station.

The "Imperial" telephone is made by the Telephone Manufacturing company of Sumter, S. C. The instruments are handsome in appearance and are said to be well made, with fine talking qualities. The company makes switchboards and telephone supplies also and is making an energetic bid for southern trade. An illustrated catalogue is sent to applicants.

Meysenburg & Badt, Monadnock building, Chicago, have just issued a neat folder announcing that they are the authorized representatives of the Weston Electrical Instrument company; Hugo Reisinger, importer of "Electra" Nuernberg carbons; the Ward Leonard Electric company, maker of the Leonard and Carpenter rheostats, starting boxes, theater dimmers, circuit breakers, etc.; the Helios Electric company, maker of open arc, enclosed arc and incandescent arc lamps, for direct and alternating currents, and the Excelsior Electric company, for electro-plating, electrotyping and electrolytic dynamos. Meysenburg & Badt take especial pains to impress the fact that they are not supply dealers, but manufacturers' representatives in these lines. They have also prepared a neat price-list of electrical instruments made by the Weston Electrical Instrument company, which should prove valuable for central station managers, as it is arranged in convenient form.

One of the largest orders for arc lamps in New York city that has been offered for competition was given on the 16th inst. by R. H. Macy & Co. to the Diehl Manufacturing company of Elizabethport, N. J. The latter is to furnish its new enclosed arc lamp No. 207, which was put on the market about the first of October. It is of special design, having the new oxidized finish that has never before been accomplished in the manufacture of arc lamps. By the use of this finish the lamp can be cleaned with a damp cloth at any time, and always retain its original high polish, thus obviating the necessity of burnishing the metal. This lamp was selected after one of the most exacting tests, in competition with other manufacturers, that has occurred in the East, several lamps having been in competitive test for over a month; and it is certainly of interest to the trade to know that the Diehl Manufacturing company has been awarded the contract after such an investigation into the merits of the lamps.

The fact that the L. P. and D. Transmitter company of Montpelier, Vt., is now in shape to do business, after some delay in reorganization, will be pleasant information for the managers of electric light stations who have not been able to consider this method of utilizing power. The entire interests of this company were purchased by John H. Senter, one of the prominent lawyers of the state of Vermont, living at Montpelier, who has appointed W. E. Laird, the inventor of the system, business manager. When in charge of the electric light station at Montpelier Mr. Laird applied his invention with such success to the apparatus in his charge that he attracted the attention of many outside interests, which resulted in the formation of a company for its sale. This system is used in connection with belt-driven units, and after 11 years' practical experience Mr. Laird has gathered a mass of interesting data in regard to his invention. Mr. Laird is also the inventor of the friction cone pulleys, but sold his interest in the device to Frank Evans of Boston some years ago.

A device for automatically turning off and on the lights in a store has recently been perfected. It is, in fact, an automatic time switch, and the Western Electric company of Chicago and New York is the agent for the United States. This switch is a double-pole, 30 ampere, snap switch, with a capacity up to 220 volts, arranged in combination with a clock. A person desiring his lights to burn until 12 o'clock, or any specified time, sets the clock as he would an alarm clock, and turns on the lights. As soon as the time indicated by the little pointer on the dial of the clock is reached the clock automatically releases a catch and the lights are turned out. The same device is used for turning on lights. Where central stations are selling light by contract to burn to specified hours these automatic time switches can be installed by the electric light company and the inspector may carry a key to the switch. By this means the company can be assured of having the light turned off at the time specified in their contracts with customers. If the customer has a meter and desires to keep his store illuminated until a certain hour he can, with perfect assurance, lock his door and leave the automatic switch to take care of any lights, knowing that he is not dependent upon the service of any watchman and that his lights will not be taking current and a bill run up on account of lack of attention.

Few appreciate the actual cost of introducing successfully on the market an article embodying a new principle. In most cases the cost of selling is found to exceed the cost of manufacturing the article. The liberal policy of the makers of the "Pioneer" enclosed arc lamp demonstrated this in forcing to the front and making a place in the electrical field for the enclosed arc lamp, and even at the old price they found the margin of profit small. The preliminary work, they consider, has now been done, and the enclosed arc lamp has attained an established position. The business has grown to such magnitude that the Electric Arc Light company early in the season took steps to enlarge its manufacturing plant, and is pleased to announce that this plant is now completed, with a capacity of 1,000 lamps per month. With the new facilities thus secured and with the large amount of business the company is doing, it is enabled to effect a saving which it is its purpose to give to the consumer. Accordingly a substantial reduction in price of the standard brass lamp is announced. This liberal policy will undoubtedly be responded to by the trade, and still further add to the demand on the Electric Arc Light company for "Pioneer" lamps. This company has always claimed this lamp to be the most perfect piece of mechanism in the market, and now the price has been placed on a level with that of makers of lamps who, the "Pioneer" people claim, have had less experience. Now that the commercial position of the "Pioneer" lamp is assured, it is understood that the owners of the Marks patents are beginning a vigorous crusade against alleged infringers.

The list of awards in the section of machine tools at the Brussels Exposition is flattering to Americans. The "grand prix," or highest possible distinction, was awarded to but three concerns, one foreign and two American: Brown & Sharpe Manufacturing company, Providence, R. I.; the Pratt & Whitney company, Hartford, Conn.; Le Progres Industriel, Brussels, Belgium. The gold medal, or next to the highest distinction, was awarded to eight foreign and these American competitors: Cincinnati Milling Machine company, Cincinnati, O.; Gould & Eberhardt, Newark, N. J.; G. A. Gray company, Cincinnati, O.; J. Becker Manufacturing company, Fitchburg, Mass.; Morse Twist Drill and Machine company, New Bedford, Mass.; Norton Emery Wheel company, Worcester, Mass.; Prentice Bros., Worcester, Mass.; Bullard Machine Tool company, Bridgeport, Conn.; Warner & Swasey, Cleveland, O.. The silver medal was awarded to eight foreign and nine American competitors. The latter were: Acme Machinery company, Cleveland, O.; W. F. & J. Barnes, Rockford, Ill.; Bickford Drill and Tool company, Cincinnati, O.; Bradford Mill company, Cincinnati, O.; Gisholt Machine company, Madison, Wis.; Landis Bros., Waynesboro, Pa.; F. E. Reed company, Worcester, Mass.; Bradley company, Syracuse, N. Y.; Hendey Machine company, Torrington, Conn. The bronze medal was awarded to four American competitors: D'Amour & Littledale, New York City; Dwight Slate Machine company, Hartford, Conn.; Hurlbut Rogers Machine company, South Sudbury, Mass.; L. S. Starrett company, Athol, Mass.

BUSINESS.

The Western Electric company is placing upon the market an ornamental enclosed arc lamp similar in style to its standard enclosed arc lamp, but finished in polished brass. The features of this enclosed arc lamp have placed it in the front rank.

The Stromberg-Carlson Telephone Manufacturing company of Chicago, one of the largest manufacturers of telephones in the country, has just gotten out a public telephone pay station sign, especially for the use of independent telephone companies. This sign is made of best enameled iron, both sides of which are alike. The size of the sign is 8 by 22½ inches, and it is very attractive. It will be sent for a nominal charge.

The Central Telephone and Electric company of St. Louis reports a greatly increased demand for its goods, having filled orders last week for complete exchange equipment at Baird, Tex., and also several long lines in Illinois, besides smaller orders from West Virginia, Georgia, Mississippi, Tennessee, Arkansas, Indian Territory, Kansas, Nebraska, Idaho, Iowa and Missouri. The progressive up-to-date policy of this company is rapidly winning recognition, and the outlook for business is bright.

Some of the salesmen of the Central Electric company of Chicago have been inflicted with incipient cases of heart failure when confronted with a circular bearing a likeness and description of the salesman and headed in prominent type "$100 Reward." A closer examination, however, tends to relieve the tension on their nervous systems, and discloses the fact that the reward is for "any man who can offer a better line of electrical supplies than" the salesman referred to. It calls attention to the salesman, and is an excellent advertisement for the house he represents.

The new Hinds patent tubular switch, which is manufactured by the Crouse-Hinds Electric company of Syracuse, N. Y., is the result of no little study on the part of Mr. Hinds, and the results which have been obtained for it in the electrical trade are reported by this concern to be beyond expectations. Overtime has been the order in the factory during the last two months, and it is pleasant to note that the company reports that business has doubled since it first began operations less than a year ago. Messrs. Crouse and Hinds are both practical men in the electrical business, and they know what is wanted by the trade.

The Standard Electric Construction company of 32 North Water street, Rochester, N. Y., manufactures Freeman's electric soldering compound, which is warranted to be non-corrosive, possessing the particular points of a good soldering flux for copper, brass, tin and all kinds of electrical work, and having the advantage that it is cheaper than acids or salts and is also a very convenient article to use. It will not spill, neither will it drip or sputter, and there is no danger of fire by wires corroding off. It also has no fumes, and will not

injure the hands. The fact that it is indorsed by the National Board of Fire Underwriters is a significant testimonial of merit. It is put up in packages of any size suited to the purchaser, and free samples will be sent to anyone making application.

A handsome descriptive catalogue, No. 3, of the Paragon fan and power motors is issued by J. P. Williams, general agent, 39 and 41 Cortlandt street, New York. This catalogue is profusely illustrated, showing the various types of the new model 1898, Paragon desk, wall bracket, suspended and upright fans. One of the novelties mentioned is the duplex motor fan, which is made with 12 and 14 inch blades. A new feature is noticed in the Paragon ceiling fan, which is manufactured to run on 110, 220 and 500 volt circuit direct current. That the trade may fully understand the manufacture of the Paragon fan and power motors, each part is illustrated by a cut, which gives the prospective purchaser a complete idea as possible of its general construction. The speed regulator is shown with the new porcelain resistance coil. Tables give data in regard to the various styles in which the motors are manufactured, and also indicating a code word, which can be used when ordering by telegraph.

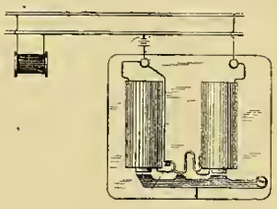
The Bossert Electric Construction company of Utica, N. Y., is now located in its new factory building at the corner of Capitol avenue and York street, in that city, where it has erected a large three-story factory building. The first story is used for heavy presswork, departments for raw material and finished work being also located on that floor. Handsome executive offices are located on the first floor. The second story is arranged for the assembling of the product, with the nickeling department and drafting room. The third story is used for special storage room for raw material and finished stock. The factory is heated by steam and lighted by incandescent and arc lights from its own plant. The company has just completed a large working exhibit of its junction boxes, which demonstrates their merit. The engine and dynamo room is located in a detached brick building, which also contains the departments for marbleizing slate, enameling boxes, a special feature being a large oven in which the enamel is hardened by steam heat, thereby reducing to a minimum any liability of the enameling cracking or flaking off. The company has a driven well with a large capacity and also city water. The factory is complete in every detail, and reflects great credit upon President Wm. F. Bossert, who planned the details. The vice-president of this company is H. P. Crouse, one of the prominent wholesale merchants of Utica, who gives much of his time to the general policy of this company. Frank G. Schofield, the secretary and treasurer, has recently connected himself with this company, and will have charge of the office details of the concern. Being a man of wide experience in the sales department of one of the largest metal concerns in the country, he will add very much to the strength of the institution.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued November 9, 1897.

593,187. Electrical Instrument. William C. Banks, New York, N. Y. Application filed March 12, 1897.

The device is composed of an electro-magnet provided with an armature, two terminals, one connected to one end of the magnet coil, a resistance, one end in circuit with the second end of the magnet coil, the other end connected to the second terminal, two contact points adapted to break and make contact with each other, one connected to an end of the magnet coil other than that which is connected to the first terminal, a short-circuit not including the resistance electrically connecting the second terminal and the second contact point, one of which contact points is mounted upon a yielding support in the line of movement of the magnet armature, whereby a sufficient excitation of the electro-magnet will cause its armature to force and hold the contact points apart and break and hold open the short-circuit, thus making the only complete circuit from terminal to terminal include the resistance, and will yet leave the magnet coil in the circuit from terminal to terminal.



NO. 593,187.

593,193. Battery Cup. James A. Britton, Phillipsburg, N. J. Application filed November 7, 1895.

A gravity battery comprises a jar, copper and zinc, and a cup provided with an open bottom covered by a textile material, and having a supporting flange about its upper edge and adapted to rest upon the upper edge of the jar.

593,230. Magnetic Circuit Breaker. Daniel M. Moore, Newark, N. J. Application filed June 24, 1896.

A circuit-breaker having a tongue or vibrating part in magnetic equipoise, and means for intermittently moving it from equipoise.

593,237. Electric Switch for Chandeliers or Brackets. Joseph W. Parkin, Philadelphia, Pa. Application filed January 26, 1897.

An electric switch for chandeliers comprises a casing having openings in its sides, a cap covering an opening in the casing, a rotatable stem in the casing, a non-conducting plug through which the stem passes, contact points carried by the plug, conductors connected with the contact points, contact devices mounted on and insulated from the stem adapted to contact with the points, and a groove in the under side of the plug adapted to sustain the conductor, whereby the plug is prevented from turning.

593,244. System of Electrical Distribution. Charles F. Scott, Pittsburg, Pa. Appplication filed January 12, 1895.

A system of electrical distribution, comprising an alternating current generator, its circuit and translating devices fed thereby, and a step-up transformer interposed in the circuit approximately midway between the generator and translating devices for raising the electromotive force to substantially the maximum limit allowable at the generator.

593,245. Apparatus for Party Telephone Lines. Charles E. Scribner, Chicago, Ill. Application filed March 16, 1897.

The system includes a normally complete metallic line circuit, appliances at different stations, and means in the line circuit for exciting the instruments through the agency of current in the complete circuit, other appliances connected with each of the line conductors, a relay at one extremity of the circuit adapted to sever the connection between the line conductors there, means at the other terminal of the circuit for applying current to either line conductor to determine the operation of the appliance connected therewith, and means controlled from the same termioal for exciting the relay to break the connection between the line conductors.

593,255. Telephone Transmitter. James W. Thomson, Bedford Ind. Application filed March 1, 1897.

A telephone transmitter is provided with a diaphragm carrying a cell containing resistance-varying material and two electrodes, one fixed in relation to the diaphragm, the other loosely suspended in the midst of the granules.

593,282. Apparatus for Assembling Commutator Bars. Sidney H. Short, Cleveland, O. Application filed April 26, 1897.

A diagonally split and compressible spring-strap or hoop in which the commutator bars are assembled radially, a casting arranged to receive the split-ring, and means for contracting the strap or hoop within the casting are described.

593,283. Construction of End Rings for Commutators. Sidney H. Short, Cleveland, O. Application filed May 3, 1897.

An end ring for commutators built up of thin sheets or strips of insulating material, the sheets or strips being lap-jointed and individually and separately bent to the required shape.

593,286. Electric Switch. Henry E. Waite, New York, N. Y. Application filed May 28, 1897.

A switch-arm is provided with a contact piece having one contact of a width less than the distance between two adjacent co-operating contacts, and having another contact piece of a width sufficient to bridge the two adjacent co-operating contacts, and means whereby either of the contacts may be brought into operative position.

593,301. Trolley. Edwin Lane and Jacob A. Snyder, Johnstown, Pa. Application filed April 24, 1897.

A pair of trolley poles is mounted on pivoted supports having apertures through which the poles pass; springs for projecting the poles are connected to the lower ends of the same and to the upper portion of the supports; yokes are carried by the upper ends of the poles and are pivotally connected with each other, and a trolley wheel is mounted upon the connecting means between the yokes.

593,314. Signaling System. Charles B. Sterling, New York, N. Y. Application filed February 25, 1897.

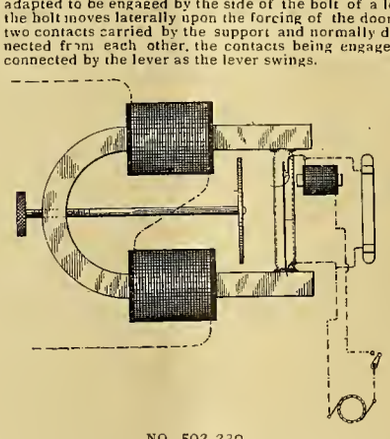
Supply conductors, a circuit-closer, an electro magnet and an automatically operating circuit maker and breaker controlled by the magnet, are included in the supply circuit, and a branch circuit including the circuit maker and breaker and a plurality of alarms, in combination with means for moving the circuit-closer into position, a lock or latch for holding it in position, and means for freeing the same.

593,332. Battery Zinc. Dora Ogden, Columbus, Ind. Application filed December 24, 1896.

There is the combination of an electrode, means carried thereby for interlocking with a similar electrode, and means by which two such electrodes may be independently held in a cell, the arrangement being such that one electrode will lie immediately beneath the other.

593,335. Lock Circuit Closer. Charles E. Pierce, New York, N. Y. Application filed July 2, 1896.

A circuit closing device for electrical burglar alarms having a support, a lever fulcrumed on the support and adapted to be engaged by the side of the bolt of a lock as the bolt moves laterally upon the forcing of the door, and two contacts carried by the support and normally disconnected from each other, the contacts being engaged and connected by the lever as the lever swings.



NO. 592,230.

593,369. Return-wire Connection for Electric Railways. John H. Bickford, Salem, Mass. Application filed March 15, 1897.

The stranded cable is separated and having several strands leading to each rail, and solid ends or connectors by which the ends of the strands are connected to the rails.

593,372. Telephone System. William W. Dean, St. Louis, Mo. Application filed July 12, 1897.

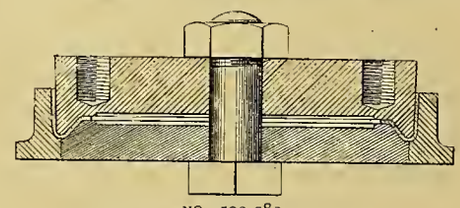
Claim is made for the combination with a telephone line and a party telephone line extending from the exchange, of a cord-circuit for forming a continuation of the first telephone line, a plurality of connecting plugs, each severally adapted to connect the cord circuit and the first telephone line with the party telephone line, signal bells at the subscribers' stations of the party line, a source of signaling current connected or adapted to be connected with each connecting plug, each connecting plug corresponding to a subscriber's station of the party line and adapted to include signaling current in circuit with the signal bell thereat, the bells at the remaining station or stations being irresponsive to the signaling current thus included in circuit with the bell at the selected station, and switching mechanism for connecting the source of calling current with or disconnecting it from the connecting plugs.

593,388. Constant Current Dynamo. Charles N. Black, New Haven, Conn. Application filed February 1, 1897.

An open coil constant current dynamo having the terminals of its individual bobbins or sets of connected bobbins connected to segments of different commutator rings.

593,389. Electrically Actuated Switch Mechanism. Walram S. Browne, Brooklyn, N. Y. Application filed June 8, 1897.

The combination is claimed with the tracks and switch, of two helices surrounding a tube of brass or other non-magnetic material, a core adapted to sliding freely endwise within such tube according to which of the helices may be energized, a stud attached to the core and passing through a slot in the surrounding tube and connected with the switch.



NO. 593,283.

593,394. Multiple Switchboard System. Fred C. Hughes and George W. Kelley, Detroit, Mich. Application filed February 1, 1892. Renewed July 26, 1897.

One claim is given: In a telephone system, the combination of the line circuit having two limbs, one of which contains an annunciator, the spring-jack connected with said limbs, the electro-magnet in circuit with said jack, said magnet controlling a circuit breaker in said limbs, a set of plugs connected by cords having a magnetic coil therein that actuates the clearing-out drop and which forms a part of the talking circuit, a cord having a source of electricity thereon connected with said plugs, which, being inserted in their respective jacks, connect the subscribers, and at the same time energize the magnets in the auxiliary line to break the annunciator circuits.

593,442. Joint or Coupling for Electric Cables. George Tailleur, Chicago, Ill. Application filed July 31, 1897.

The combination is claimed with the conductor or cable ends, of interlocking terminals, insulating sleeves having bores within which the terminals fit, and a coupling for uniting the sleeves comprising interiorly and exteriorly threaded cylindrical parts adapted to be secured together.

593,467. Tip for Telephone Cords. John W. Gottschalk, Philadelphia, Pa. Application filed October 6, 1897.

There are an electrical conductor, a pin and a clamp having a perforated end slipped over the pin, with means for holding the clamp onto the electrical conductor.

593,481. Automatic Circuit Breaker. William G. Lowrie, Newark, N. J. Application filed April 24, 1897.

There is the combination of a source of electric energy, a magnetic field created thereby, a circuit-breaker controlled by the magnetic field, and means for short-circuiting the field and breaking the circuit when the current exceeds a certain strength.

593,504. Automatic Block Signal. James M. Williams and Thomas P. Kinney, Danville, and Harry W. Kinney, Lynchburg, Va. Application filed May 28, 1897.

In this combination there is a signal-arm mounted thereon, a motor for operating the arm, gearing for connecting the motor with the arm, a gear-wheel of the gearing being loose upon its shaft, arms rigidly secured to the shaft, spring-controlled stops loosely mounted upon the loosely mounted gear-wheel adapted to engage the arms for imparting movement to the shaft, the construction being such that the motor is enabled to attain a degree of velocity before it actuates the arm, and means for electrically controlling the motor.

593,510. Electric Circuit Controller. Joseph H. Bowley, Washington, D. C. Application filed February 24, 1897.

An automatic regulator for electric circuits is described, consisting of a receptacle having a base and neck portion, the neck having an upper and lower compartment, a float mounted in the lower compartment of the neck, a standard erected upon the float and in the neck, and having fingers designed to engage the ends of the wires forming the circuit.

Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, NOVEMBER 27, 1897. No. 22

Additional Power Facilities at Niagara Falls.

By Orrin E. Dunlap.

The enlargement of power plants seems to be the order of the day at Niagara Falls. For several months the Niagara Falls Hydraulic Power and Manufacturing company has had a large force of men engaged in building an addition to its power house and increasing the capacity of the plant at all points in order that more power might be made available. This company, it will be recalled, controls the surface canal at the Falls, its factory district being located on the edge of the high bank of the lower river, while the power house is situated at the water's edge in the gorge below. No doubt many readers of the Western Electrician have visited this novel installation while attending some of the conventions in the Power City, and well understand the value of the development, as well as its method. The first section built of the power station is 60 feet long by 100 feet wide. In it are eight generators, which supply power for the "Great Gorge Route" and for the lower works of the Pittsburg Reduction company, which are located at the edge of the cliff on the bank above. These generators are operated by four turbines made by James Leffel & Co. of Springfield, O. The installation has been in every way so satisfactory that the company very early started to increase the capacity of the plant by building an addition on the south end. This new section is similar in dimensions to the original section, making the present dimensions of the station 120 by 100, and to this, at some later period, it is intended to add still another section 60 by 100, thus making the size of the building in its complete form 180 by 100.

The roof of the new section is of the steel truss pattern, identical with that of the first section. The walls are of the most substantial masonry, very wide at the foundation. The inside wall is built close up to the cliff. It is probable that the south end will be enclosed by a temporary wall, possibly the partition now in the south end of the first section, which will be taken down to throw the two sections into one room. The new tail race beneath the power house floor is a little deeper and wider than the old one. Its walls are of the best ashlar masonry, the stone used being somewhat similar to that quarried on the site. A departure has been made from the plan of building of the old tail race, the new penstock and wheels being supported by a series of heavy posts and beams, all parts of which will be made adjustable by keys. This part of the work will be done by the Variety Iron Works of Cleveland, O.

It is intended to install five wheels of 2,500 horse power each in the power house addition, and the first of these has been ordered from R. D. Wood & Co. of Philadelphia. There will also be two smaller wheels to operate two exciters, to be placed on the power house floor to furnish current to the fields of the generators. The first generator to be placed in service will supply current to the new plant of the National Electrolytic company, now in course of erection adjoining the Cliff Paper company's mill on the bank above. This generator will be made by the General Electric company and will be of about 1,200 horse power. It will have 14 poles and make 257 revolutions per minute, giving an output of 5,000 amperes at 175 volts. It will be most carefully designed in order to enable it to cope with the severe electrolytic work. It will be directly connected to the shaft of the turbine. Other wheels and generators will be added to the station as the demand increases until the installation is complete.

While the power house work has been going on down in the gorge, another gang of men has been busy at the top of the bank extending the forebay (Fig. 2), in order to afford water connection and assure a water supply. The new section of the forebay will have walls made of concrete, some of them being veneered with stone. The dimensions of the extension will be about 100 feet long, 30 feet wide and 22 feet deep. It is being built on the south end of the first section, in the rear of the aluminum works, and right at the edge of the cliff. It is proposed to connect this latest section of the forebay with the basin of the main canal by a canal about 300 feet long, 22 feet wide and 20 feet deep. This proposed canal will run along the south side of the aluminum works and afford a second connection between the canal basin and the forebay. At present it is thought that the first connecting canal between the forebay and basin will afford ample water supply for the present contemplated installation, but as soon as necessary the new canal will be built. The gates, racks, etc., with the exception of the waste gates, in which an improvement will be made in order to overcome the ice difficulty, will be very similar to those in the original installation, and, with the floor covering the forebay, will be furnished by the Buffalo Bridge and Iron Works.

The penstock will be made by Struthers, Wells & Co. of Warren, Pa. It will open into the forebay with an elliptical bell mouth about 20 by 11 feet. Leaving the forebay it will extend out horizontally about 60 feet, then run vertically about 200 feet down to the power house. It will be 11 feet in diameter until it passes beneath the power house, and then for about 50 feet it will be 13 feet in diameter until it passes one or two wheels, when it will be reduced to seven feet and finally taper off into a cone 18 inches in diameter to form a head, ending in an air chamber four feet in diameter and 15 feet high. The steel from which it will be made will vary from five-sixths to 1⅛ inches in thickness. As it will stand out from the cliff, it will look like a huge column, and be of an imposing nature. The old penstock is eight feet in diameter and hugs the cliff in its descent to the power house.

The canal that will supply the water for the power

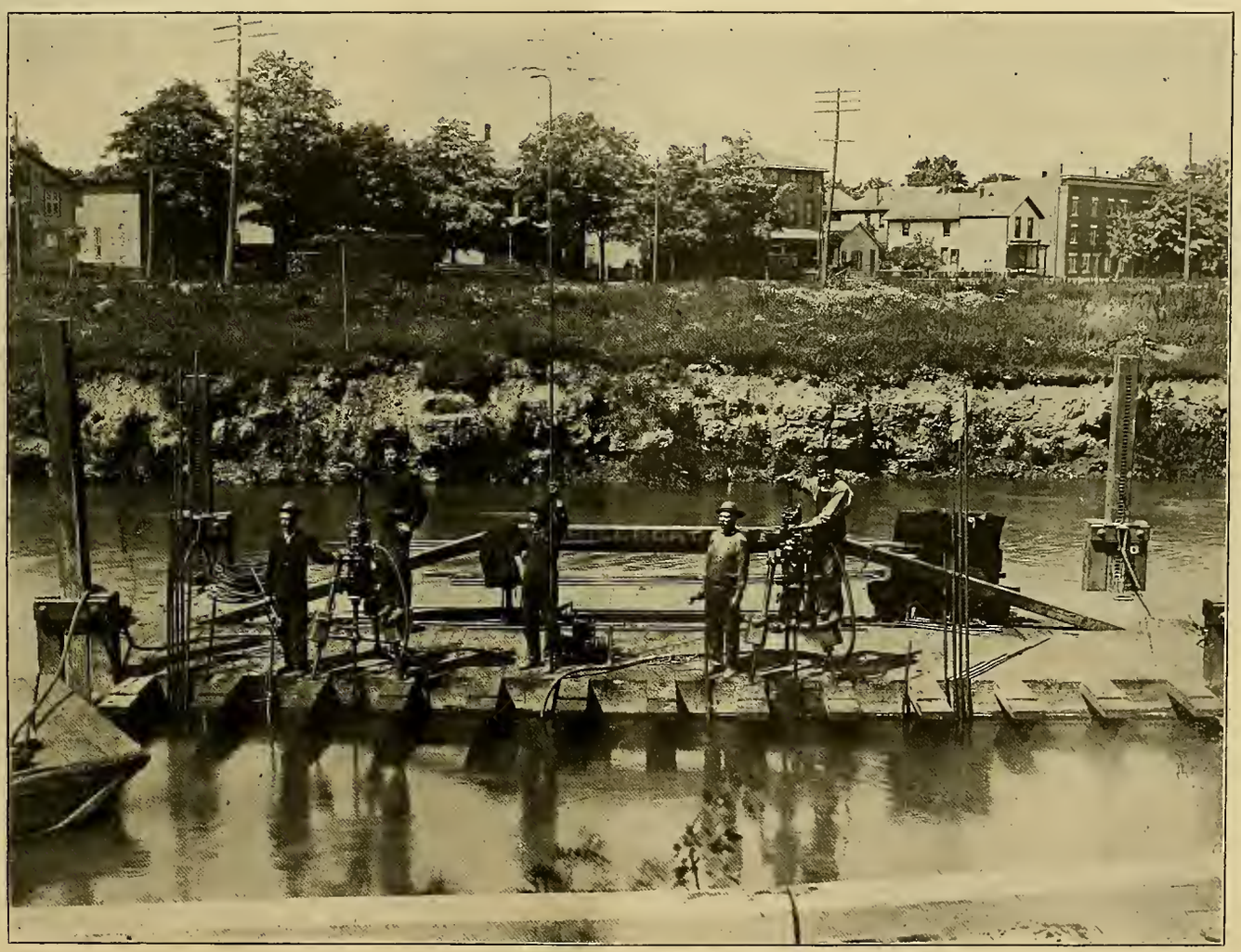


FIG. 1. ADDITIONAL POWER FACILITIES AT NIAGARA FALLS.—DRILL BOAT.

house extension is one of the oldest waterways in Western New York. When the Niagara Falls Hydraulic Power and Manufacturing company obtained control of it, it was a listless stream flowing unused through the village and over the bluff. Many thousands of dollars have been expended in developing its resources, and the state recently formally recognized the company's right to take water from the upper Niagara for power purposes. For several years the company has had men and dredges at work widening and deepening the canal, with the result that the water supply it affords has greatly been increased. The width of the canal at Port Day is now 250 feet, narrowing to 100 feet in 400 feet of length. From this point down to the basin it is about 70 feet wide, but the company owns land enough to widen it to 100 feet. For about 30 feet of its width the canal is eight feet deep, and for the remaining 40 feet it is 14 feet deep. This latter channel has but recently been blasted out, the company having a drill boat, two dredges and a tug, in order to carry on the work with all possible rapidity and economy (Fig. 1). It was quite an attractive sight many times to see the blast set off (Fig. 5). Sometimes the water was thrown in the air in beautiful form. As the blasts broke the rock it was picked up by the dredges, placed in scows and taken by the tug up the canal to Port Day (Fig. 3), where it was raised from the scows by a large derrick and dumped in great piles (Fig. 4), and afterward used in various ways. The 14 foot channel runs along the north side of the canal down to Third street, where it crosses to the south side and continues down to the basin, on which part the drill boat and dredges are now at work. The work on the canal, on the forebay and power house extension is all done by the day, and not by contract, as in many cases of the kind, the power company finding this a very satisfactory way of doing things. Wallace C. Johnson, chief engineer of the company, is in full charge and plans all the work, while F. C. Lott, the electrical superintendent of the company, is in charge of the electrical installation and all of the electrical work. Mr. Lott is also manager of the Buffalo and Niagara Falls Electric Light and Power company, thus coming in touch with the output of both of the great Niagara Power companies. Arthur Schoellkopf is the secretary-treasurer of the Niagara Falls Hydraulic Power and Manufacturing company and gives close personal attention to the work. He is, in fact, the business head of the company.

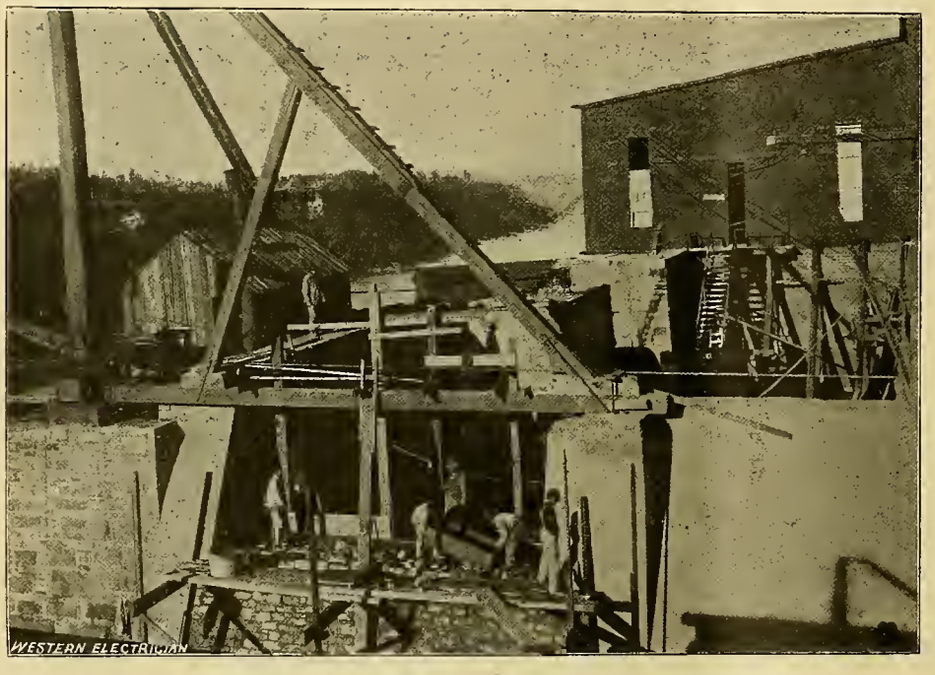


FIG. 2. ADDITIONAL POWER FACILITIES AT NIAGARA FALLS.—BUILDING THE FOREBAY.

Canadian Power Project.

Interest has been revived at Niagara Falls in the water power privileges controlled by the Welland Power and Supply Canal company, a Canadian company incorporated by special act of Parliament of the Dominion for the purpose of utilizing the water power of the Niagara River and Welland Canal for promoting manufacturing enterprises. The organization of the Canadian Power League has had a tendency to arouse public interest to a great extent in power projects, and this interest has given new life to the company mentioned.

In addition to this, the ire of the commissioners of the New York State reservation at Niagara has been aroused, and at their annual meeting, held in New York city, on Thursday, November 18th, President Andrew H. Green was authorized to take steps to secure by international agreement the protection of the falls and upper river. This step was no doubt taken owing to the announcement that the plan of the Welland Power and Supply Canal was not dead, but that efforts were being made to carry the project to completion.

The power plan of the company is very similar in its idea to that now in process of development at Massena, but it is recognized as being far superior to the Massena project, because just as large a volume of water will be available for power purposes, while the head of water obtainable will be nearly four times as great, meaning, of course, greater power and more of it. Two miles above the falls, on the Canadian side, is the little historic village of Chippawa, and there the Welland River or Chippawa Creek flows into the upper Niagara. This small stream has so slight a descent that a little deepening of its bed would cause it to flow the other way. Therefore it is felt that by enlarging its channel it can be made the outlet of a goodly portion of the water that now passes over the Horseshoe Fall. Five miles from the mouth of the river the body of water would be emptied into a canal that would carry it to a point on the Niagara escarpment or bluff, which is a continuation of the Queenston Heights, where a fall of 150 feet would be obtained, the water to be carried in huge penstocks from the canal basin or reservoir on the top of the bluff to the wheels below.

The mountain or bluff to which it is thus proposed to transfer the power resources of the Niagara runs along on both sides of the river for miles. The scheme proposed by the Welland Power and Supply Canal company is very similar to that of the Model City company on the New York state side, with the slight advantage that in the Welland River it has a channel for its canal for a portion of the distance. The proposed canal, according to the present plans, from the Welland River to the bluff would be about 100 feet wide, 14 feet deep, its length being several miles. It is estimated that 150,000 horse power could be developed.

The men interested in the company are mainly from St. Catharines, Ont., Wallace C. Johnson being their consulting engineer. It is estimated that a capital of $5,000,000 would be required to complete the project and put the entire plant in operation.

Considering the variety of questions that have arisen as to the rights of companies to divert water from the Niagara River, which is an international boundary, the right of the Dominion to authorize the diversion of so much water as is proposed from the river may be questioned. It is apparent to anyone knowing the relations of the Niagara River, Welland River and the line of the proposed canal that if the new waterway was made large enough the entire body of water, at least the greater part of it, now passing into the river from Lake Erie could be made to flow through the new channel, and thus the Dominion would be in full possession of all the power developed from the Niagara, not only depriving New York state of its great power development, but the world of that sublime spectacle, the Falls of Niagara.

American Advantage in Electric Railway Work.

In a contribution to the London Electrical Review upon "Twenty-five Years of Electric Traction," Philip Dawson says:

"After having been practically the first in the field as regards electric traction for nearly 12 years, England rested on her oars without even making an attempt to find out what was being done in America and on the Continent of Europe, or to profit by the experience of others.

"The American manufacturers soon realized the fact that England would shortly be a fine field, and they, therefore, took every conceivable trouble to educate tramway companies, engineers and corporations, and with such success that now, when at last we have overcome the bugbear of æsthetic objections, and when nearly all tramway companies and corporations are going in at once for electrifying their whole systems, there is not one English manufacturer who is able to compete in price or quality with American-made goods.

"No corporation or tramway company can possibly afford to put in experimental work, or to allow contractors who have not done good work before, to gain their experience at the expense of tramway owners or those who are going to work the line and wish to make it a financial success."

Proposed British Cable to Australia.[1]

As several incorrect and misleading statements on this subject have been recently made public, a few facts relating to the proposition laid before her majesty's government may be of interest. The first part of the project is to lay cables from Porthcurnow, in Cornwall, to Gibraltar (1,198 knots), Gibraltar to Sierra Leone (2,379) or Bathurst, thence to Ascension (1,168), on to St. Helena (810), and from there to Cape Town (1,910). This will afford a triplicate route to South Africa largely clear of existing cables, and not likely to be affected by causes producing interruption of the present lines, such as earthquakes, or, in the case of cables on the coast, river floods. All experience shows that duplicate cables, even when separated by such a continent as Africa, do not afford sufficient security against interruption of communication, and the new route referred to will, if laid, be welcomed by all connected with South Africa as diminishing the risk of communication being cut off.

The second part of the scheme is to lay a cable from Natal to Mauritius (1,818 knots). This, in conjunction with the present Zanzibar-Seychelles-Mauritius line, will also have the effect of providing an alternative to the following section, should they at any time be interrupted: Zanzibar-Mozambique (already duplicated), Mozambique-Delagoa Bay, and Delagoa Bay-Durban. From Mauritius the route may be to Rodriguez Island (406 knots), thence to Cocos or Keeling Island (2,218), and on to Perth, Western Australia. It is proposed that these cables should be laid by the Eastern, the Eastern and South African, and the Eastern Extension, Australasia and China Telegraph companies.

When completed this new route from England to Australia will form a very considerable addition of about 13,684 nautical miles to the existing submarine cables, which have been manufactured and laid by British industry and enterprise, and are worked by British clerks. As already stated, the new cables will land only in British possessions, and will form a triplicate route to Australia, removed from the volcanic dangers of the Java seas; while experience on both sides of Africa shows that interruptions from seismic disturbance there are not frequent.

This scheme is put forward in the judgment of the companies concerned as being preferable in every way to the Pacific route to Australia, where a single break in the chain would interrupt communication; while in the proposed scheme, except in the case of the cables from Mauritius to Perth, if any of the sections were broken there would be two alternative lines as far as Zanzibar, and one between that place and Mauritius. Some of the depths in the Pacific are very great, while in the projected line the recorded soundings indicate no depth greater than cables already are lying in. Again, in the Cape route the distances are all practicable without making the cables too expensive, because in a section much above 2,000 miles in length the amount of copper and gutta-percha insulation would have to be largely increased to secure a good working speed.

In place of the route given above it has been erroneously stated that the projected lines were to go from Mauritius to Ceylon, Singapore and Batavia to Australia; and in one press reference to the matter it has been stated that such a cable would be liable to prohibitive dangers from seismic interruptions, but it may be pointed out that existing lines from Madras to Australia have not by any means ruined the proprietor company by the cost of repairs, and that communication between this country and Australia has not once been interrupted since 1890. This pessimistic view of the matter is supported in the case referred to by attributing all the interruptions which have occurred during periods of from nine to 17 years on the Madras-Penang, Singapore-Batavia, and Java-Port Darwin cables to a single year, and further giving a seismic or volcanic cause to all the breaks or faults which have occurred on these sections; whereas most of the trouble of the early days was due to the teredo boring-worm and abrasion over rocky ground. Fortunately an effectual remedy appears to have been found in respect to the former danger by the adoption of a brass taping laid spirally round the gutta-percha insulator, and, in regard to the latter, the cable was relaid on a better bottom. When it is remembered that interruptions may be due to many other causes—from a fishhook to a whale—it may be seen how greatly the earthquake danger has been exaggerated. Finally, it may be said that the land-line communication between Perth and the south and east of Australia is ample and reliable.

1. From the London Times.

American Goods in Australia.

American exporters to Australia appear to take precautions that, according to the consular reports, are sometimes lacking in the efforts to secure European trade. An Australian merchant, in a long letter to the London Times, tells of the superiority of American to British methods in securing a market for manufactured goods in his country.

The American manufacturer or responsible manager dictates his correspondence to a shorthand typewriter, and with the invoice, the Australian says, sends also valuable information. The invoices also are typewritten, and the extensions are carried out in parallel columns in dollars and sterling at the current rate of exchange, and by means of carbon copies are furnished in triplicate. This latter is a prized facility, giving one copy for use by the importer's clerk at the custom-house, another by which the stock office can work out the cost, and a third for the ledger accountant and transactions with the bank.

FIG. 3. ADDITIONAL POWER FACILITIES AT NIAGARA FALLS.—TUG TAKING EXCAVATED MATERIAL TO PORT DAY.

The American excels the manufacturers of all nations in his printed matter. His catalogues are admirably illustrated, printed on good paper, strongly bound. If so requested, he will print the name of the importer on every sheet, and also the latter's selling prices instead of his own. The agricultural-implement catalogues are marvelous productions. In the case of reapers and binders, every separate part is illustrated and numbered, and to each a code word is attached, also the importer's price for that part. In case of a break at harvest time, a farmer living a hundred miles away can telegraph the code word for the broken part, and thus reduce delay to a minimum.

The British manufacturer sends his agent to every importer, gets all the orders possible from that class, then goes to the smaller dealers and does the same. This has become so general that many large importers now refuse to have dealings with British salesmen. The American agent goes to the largest house in his particular line and offers him sole control of his goods. He also goes to the large farms and shows how to operate the machinery, without expense to the importer.

The American has made the packing of goods sent to Australia a fine art, it seems, and has been so successful that no damage is done by the severe handling received on wharves or railways. But the best thing about the American manufacturer is, according to the Australian writer, that he never disputes with a customer—he knows it does not pay—while his British competitor invariably disputes any claim for damages. An Australian farmer wrote the importer of whom he bought some American plows that the molding-board of one was broken. The letter was forwarded to the American makers, who promptly replied: "This is the first time that we have been notified that one of our molding-boards has been broken by fair wear and tear. Express our regret to your farmer, send him three new ones and charge all expenses to our account." That farmer was turned into a walking advertisement at very slight expense.

Raising a Stranded Cruiser.

Electrical appliances have been of much service to Russian engineers in the recent work of raising a great ship. The cruiser Rossia, 480 feet long and of 12,000 tons displacement, one of the largest ships of the Baltic fleet of Russia, ran aground a year ago on a bank of the Neva in 20 feet of water. The water fell afterward so that the boat pressed on the sand and gravel below with a load of 2,500 tons. Attempts to pull her off having failed, the admiralty applied to the imperial school for divers at Kronstadt. Operations were begun in the middle of winter, when the ice was so troublesome that the cruiser could not be kept clear, and the operations had finally to be conducted from tents erected on the ice. The first thing was to ascertain exactly how the boat was lying. For this purpose long poles were fixed in the bottom in an oblique position close to the hull, the divers, descending along these poles and communicating by telephone with the men above, took their measurements by means of the plumb line. The rudder was found to be free; most of the keel was buried in the ground. When the relief had been mapped out, an iron pipe 60 feet long and two feet in diameter was inserted in the soil underneath the keel, and the keel cleared in this way. The hydraulic current was so strong that one of the divers was upset, though 60 feet away from the mouth of the pipe, and the 200 candle power electric lamps which the divers had did not penetrate through more than a foot of the turbid water. But the process was entirely successful. By the middle of December only a small part of the keel was still embedded. The operations were carried out in a thoroughly scientific and practical manner. The success is partly attributed to the telephone and the electric lamps, which did a good deal to cheer the divers up. They could never bear the cold for more than half an hour. The outfits had been obtained from France. In the cold water the rubber shirts became quite brittle and had constantly to be reheated; the air pumps also needed heating; the automatic valves contracted so much that the divers were soaked; the leather collars of the helmets broke when the divers put their dress off again.

Safe Carrying Capacity for Electrical Conductors.[1]

By C. H. Sewall.

The proper amount of metal in an electric conductor sufficient to transfer a given energy is governed by loss and carrying capacity.

Any conductor offers a resistance to the passage of current causing a certain loss in energy, which passes from it in the form of radiated heat. The resistance offered is directly proportional to length and inversely to cross-sectional area. A long conductor has large radiating surface in proportion to the amount of current developed, and, consequently, in a connection between two points a considerable distance apart, the limit of economy in loss is generally reached without undue heating.

On the other hand, a short conductor, by reason of its low resistance, will cause a heavier current to flow; and owing to the small extent of surface exposed for radiation may develop a temperature dangerous to its surroundings, while the loss in energy still remains within proper bounds.

FIG. 4. ADDITIONAL POWER FACILITIES AT NIAGARA FALLS.—STONE PILES AT PORT DAY.

In the common acceptance of the term, carrying capacity means safe current capacity; that is, the current which may be carried without danger for a given cross-section.

The carrying capacity of a conductor is expressed by the number of amperes of electric current it will transmit without exhibiting more than a specified increase in temperature above that of its surrounding medium; and it is safe when that specified increase is safely limited.

To determine the proper limit is the undisputed prerogative of fire insurance companies. These companies have formed associations for mutual protection, and the culmination of this organization is the National Board of Fire Underwriters, which issues a code of rules to be observed by property owners who desire to be insured by any of the companies in the associations. Municipal ordinances have been made in conformity with insurance rules, so that both the insured and the uninsured are bound by them.

Recently delegates from nine different bodies, including the American Institute of Architects, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Street Railway association, Factory Mutual Fire Insurance companies, National Electric Light association, National Association of Fire Engineers, National Board of Fire Underwriters, Underwriters' National Electric association, have united in framing what is called the National Electrical Code for the government of the installation of electric wires and apparatus. It has been adopted by municipal arthorities generally, and is now, for all practical purposes, as much the law of the land as if it had been decreed by state or national legislature.

So far as the code relates to carrying capacity of conductors, it prescribes, in a table, a maximum number of amperes that can be sent through wires made from pure copper of 98 per cent. conductivity for three different conditions, and covering a range from No. 18 B. & S. gauge to 2,000,000 circular mils.

Here is a tabulated abstract from the national code:

Cir. Mils.	Amperes rubber covered.	Amperes, W. P. wires.	Amperes, marine work.
2,000,000	1,050	1,670	.....
1,000,000	650	1,000	.....
500,000	390	590	.....
413,639	.....	.....	340
250,529	.....	.....	235
B. & S. G.			
0000	210	312	.....
0	127	185	.....
6	46	65	.....
14	12	16	12
18	3	5	3

It is the purpose of this paper briefly to discuss the general physical laws and conditions which bear upon the subject.

One of the old rules for determining safe current capacity was that of Clark, Ford & Co., English wire manufacturers. It allowed 10 pounds of copper per mile for each ampere of current. Translated into familiar terms this means that No. 18 B. & S. carries 2½, No. 6 12, and No. 0000 330 amperes. I will put them on the board opposite the figures of national code for same sizes:

Size.	R. C. wires.	C., F. & Co.	W. P. wires.
0000	210	338	312
6	46	42	65
18	3	2¼	5

Taking averages for all conditions, this ancient rule of thumb is not so far out of the way for those sizes with which the early manufacturers were familiar.

Subsequently the British Board of Trade established the rule of 1,000 amperes per square inch of cross-section.

Here is the comparison with the code:

Cir. Mils.	R. C. wires.	B. T.	W. P. wires.
2,000,000	1,050	1,570	1,670
1,000,000	550	785	1,000
4-0	210	166	312
0	127	83	185
6	46	21	65
14	12	3¼	16

In March, 1884, Prof. George Forbes read a paper before the London Institution of Electrical Engineers, in which he exhibited mathematical calculations showing the number of amperes necessary to raise wires of given diameters to certain temperatures, and also calculations as to the effect of insulated coverings. He pointed out that the Board of Trade rule, 1,000 amperes per square inch, was uneconomical for small conductors and actually unsafe for those of large, though perhaps unusual, diameters.

A. E. Kennelly read before the Edison convention at Niagara Falls, in August, 1889, a description of a series of experiments furnishing a great amount of reliable information. He did not, however, make experiments nor calculate tables upon the stranded conductors that are generally used when larger than 0000 B. & S. is required; and as the conditions in stranded conductors are quite different from those in solid ones, there was still uncertainty as to the proper current for large leads.

FIG. 5. ADDITIONAL POWER FACILITIES AT NIAGARA FALLS.—BEAUTIFUL BLAST.

In November, 1896, Mr. Merrill, electrician for the Chicago Board of Fire Underwriters, made experiments in a station of the Chicago Edison company, the results of which were issued in his laboratory report No. 523, and are now published as part of the code.

The maximum temperature to which a conductor may be raised must be limited by several considerations:

1. Heat increases the resistance of conductors.
2. Heat decreases the resistance of dielectrics.
3. Some kinds of dielectrics, notably rubber, will soften at high temperatures and permit the metal

1. Read before the Chicago Electrical association, November 5, 1897.

to sink into them, bringing it nearer the surface of, or, possibly, quite through, the insulating covering.

4. The temperature may rise to such an extreme as to cause a conflagration.

In 1888 a committee of the London Institution of Electrical Engineers reported the following rule:

"The conductivity and sectional area of any conductor should be so proportioned to the work it has to do that if twice the current proposed be sent through it the temperature of such conductor shall not exceed 150 degrees F."

If 150 degrees F. is the maximum limit, it is hardly possible to better the rule. It is supposable that no one will object to a factor of safety of two. The writer knows of one instance where, under very careful experimental conditions, a fuse that had been long in service successfully resisted current of twice its rated capacity.

As a starting point Mr. Kennelly thought that 75 degrees F. represented a fair average condition, and his experiments were built up from that point. It was assumed that the temperature would increase as the square of the current strength. That being the case, a current sufficient to increase the temperature 18 degrees F. (to 93 degrees) would, if doubled, raise it four times 18 degrees, or to 147, and just within the committee's danger line.

As Mr. Kennelly's figure for 0000 insulated wire run in molding is 175 amperes, and the new code gives 210, then the rise in temperature under the latter figure will be as 175^2 or 30,625 is to 210^2 or 44,100; and as the former rise was 18 the latter will be 28, and doubling the current we shall have 112, or to a maximum limit of 187 degrees. But 75 degrees is not the maximum condition. It is conceivable that on a July day paneled wires may be surrounded by a medium showing 100 degrees F., and it seems fair to suppose that if double the current in

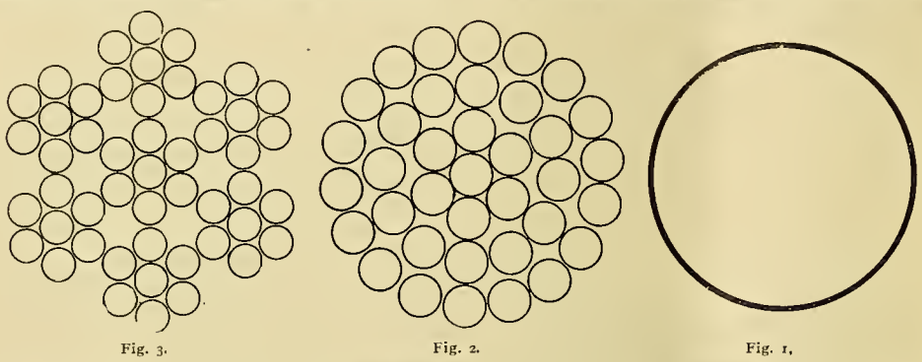


Fig. 3. Fig. 2. Fig. 1.

Fig. 4.

SAFE CARRYING CAPACITY FOR ELECTRICAL CONDUCTORS.

amperes given in the present code should be sent through a wire in the condition indicated, its temperature will be raised to 212 degrees.

Temperature limitations in an electrical conductor depend upon:

1. Electrical conductivity.
2. Extent of radiating surface.
3. Nature of radiating surface.
4. Nature and condition of surrounding medium.
5. Specific heat of metal.

Extent of radiating surface depends first upon form, a thin, flat strip having the greatest, a round solid wire the least. A stranded conductor has, for the same ohmic resistance, a larger circumference than a solid one, and its surface is corrugated.

The cuts illustrate the effect of form on radiating surface. Fig. 1 represents the cross-section of a solid conductor. Fig. 2 is the same circular millage made into a concentric strand of 37 wires. Fig. 3 is the same section in a cable containing seven strands, each strand of seven wires. Fig. 4 is the same surface in a rectangular cross-section.

Approximately the distances around them, counting in all curves, in corrugations are as follows:

	Linear inches.
Circle	8.27
Strand	12.22
Cable	14.14
Bar	22.73

And their radiating surfaces for equal lengths are in that proportion.

Roughened surfaces will give off heat faster than polished ones. If thoroughly blackened the coefficient of radiation is twice that of a polished surface. If covered with a black insulating covering radiation will be still further promoted. Prof. Forbes' calculations showed that the greater surface obtained by applying an insulating covering more than compensated, up to a certain thickness of coating, for the poor thermal conductivity of the insulator, and this was borne out by Kennelly's findings. Two of the latter's curves disclose the fact that a rubber-covered wire with an insulation 73 mils thick had a temperature elevation 30 per cent. lower than that attained by a wire of the same diameter but only covered to a thickness of 11 mils. From the tests the evidence was distinct that the effect of an insulated covering was to cool the wires if the covering was black; wire wound with white cotton was found to be higher in temperature, with the same current, than a bare one.

For a gutta-percha covering it is supposed that radiation will be better than with rubber. Prof. Forbes makes the proportion of thermal conductivity as 48 to 41 in favor of gutta-percha as compared with rubber.

It is also highly probable that a conductor with an ordinary wall of insulating material encased in lead will bear more current than if protected by rubber or gutta-percha alone. Mr. Fisher of the Standard company placed upon a wooden floor four cables running side by side in the form of an elliptical spiral. Unfortunately, full data are not given, but the calculated tables from the experiment show, for a rise in temperature of 25 degrees, about the same figures as the national code, and as the cables lying side by side must have heated one another, it is a fair inference that their radiating properties under even conditions are rather better than for bare wires. Undoubtedly cables suspended in air will carry much more than the code allows. If underground much will depend upon conduit ventilation.

After heat has been brought to the surface of a conductor and is radiating therefrom it causes the particles of air in its vicinity to move away and to be replaced by others, which are again moved and replaced, and so on. This process is called "convection."

The experiments of '89 showed that a No. 10 B. & S. bare copper wire in a room from which drafts of air have been carefully excluded will be raised in temperature 18 degrees F. from 75 degrees F. by 26 amperes, and will require 42 amperes to bring it to the same temperature if the wire be suspended out of doors upon a calm summer day.

In a room guarded against outside drafts the agitation of a fan near a current-bearing wire sensibly decreased its temperature elevation.

The influence on radiation from convection and from color also may be seen by grouping figures from experiments for No. 0000 B. & S. gauge under four different conditions, viz.:

	Amperes.
Brigbt bare copper in a room with still air	162
Blackened bare copper in a room with still air	200
Brigbt bare copper out of doors, calm weather	322
Blackened bare copper out of doors, calm weather	340

starting with the same temperature elevation and attaining the same rise.

The influence of extent of radiating surface is shown by comparing code allowances for the same cross-section; first, in one conductor No. 0000 gauge, 210 amperes; second, in two conductors of one naught gauge, 254 amperes, 21 per cent. increase.

The percentage increase from one 2,000,000 circular mils conductor to two of 1,000,000 circular mils each is from 1,050 to 1,300 amperes, or nearly 24 per cent.

It may be convenient to remember that with large conductors there can be gained from 20 to 25 per cent. in cooling effect by making a lead of two conductors of one-half the cross-section required, instead of using one conductor with the whole cross-section required.

While convection is not directly proportional to radiating surface, it seems to be to length, and Mr. Kennelly gives as an approximate rule that in still air the loss of energy due to convection has a mean value of 0.00175 watt per linear centimeter for each degree Centigrade of temperature elevation, or one kilowatt for every 114 meters at 50 degrees C. temperature rise.

Different quantities of heat are required to raise the temperature of a given weight of different substances a certain number of degrees. This is called specific heat. For the reason that the specific heat of iron is 25 per cent. greater than that of copper, we may expect to find that iron wires safely carry more current than is indicated by their compared resistance with copper for the same cross-section.

For metals other than copper I have been able to find but little information. Mr. Preece in 1888 furnished very complete data on fusing effects, but as these involve the capacity of the metal to resist melting, they are not reliable guides to effects of moderate heat. In a catalogue issued some years ago there are tables for carrying capacity of iron. These give for the equivalent in cross-section of No. 10 B. & S. in galvanized iron wire a maximum safe current of 12 amperes; for tinned wires, 12.3 amperes. These figures are about one-half the code allowance for same size rubber-covered copper wire. The resistance given in the same table (6½ times that of copper) indicates a low grade, electrically, of iron wire.

In the same book German silver, No. 10 B. & S., having a resistance 16 2-3 times greater than copper, is allowed a safe carrying capacity of 8.5 amperes. The 16 per cent. German silver wire usually found in the market of to-day has a resistance 18 times that of copper.

No further explanations as to conditions accompany the table just mentioned.

It is a law that the temperature of a conductor increases as the square of the current strength if the resistance is constant. As temperature rises resistance increases; but it is also the fact that greater activity in radiation and convection tend to offset the effect of higher resistance, and experiments have shown that, in a wire which is given a fair chance to part with its heat, the rule approximately holds good for an indefinite time.

For the same reasons and under the same conditions, with a given rise in temperature the square of the current varies as the cube of the diameter of a round wire.

The law governing safe temperature of a round wire is expressed by the formula $C=ad^{\frac{3}{2}}$ where C is the proper current in amperes, d diameter, a the constant which is applied to suit conditions under which the wire is to be used. Kennelly's constant for insulated wire in molding is 560, if d be in inches.

Solid No. 0000 B. & S. is .46 inch diameter. That figure raised to the $\frac{3}{2}$ power is .312; $.312\times560=174.72$ amperes, which was for a long time the underwriters' rule for No. 0000.

As the limit has been raised to 212 for rubber-covered wires, it follows that the present constant is $212\div.312$,, or 680 (nearly), and for weather-proofed wires $312\div.312$, or 1,000.

For stranded conductors let us consider a familiar size, 500,000 circular mils, which by the latest catalogue (Roebling's) is of a diameter .819. For ease in computation call it .82 (for neither stranding nor carrying capacity are as yet exact sciences); $(82)^{\frac{3}{2}}$ is .742. Code amperes for 500,000 circular mils are 390, which divided by .742 gives 526 as the constant for rubber-covered strand. A similar process will show 800 to be the constant for weather-proof strand.

It will be noted that the constants for stranded conductors are smaller than for solid ones.

This is because the diameters for strands are larger, in proportion to resistance, than for solid ones.

Previous to issuance of the present code the only rule as to stranded wires that I was able to find was given in an English publication by Stuart A. Russell on electric light cables. Speaking of Mr. Kennelly's constant for solid wires (560) he said: "When stranded conductors are used it must be remembered that their resistance is about 28 per cent. greater than that of a solid conductor of the same length and diameter, owing to the loss of space in stranding; and therefore the formula given must be modified so as to take this into account. It is evident that the same amount of heat will be generated whether the current C is passed through a resistance R or a current

$$\frac{C}{\sqrt{1.28}}$$

is passed through a resistance 1.28 R, and therefore for stranded wires the constant 560 must be divided by

$$\sqrt{1.28},$$

making the formula $C=500d^{\frac{3}{2}}$."

Acting upon this suggestion the writer, some years ago, calculated a table for strands. Apparently English manufacturers made their strands smaller in diameter than the Americans, and my constant figured 487 instead of 500. But it was questionable whether air in the inter-spaces of a strand would not so retard radiation as practically to counteract effect of larger outside surface.

Mr. Merrill's results have demonstrated that there is a counteracting influence, for the constant of 487 corrected by results of experiments becomes 434 for a limiting current of 174 amperes for 0000 (the old rule).

It is probable that there is neither gain nor loss, so far as heating effect is concerned, by making conductors in concentric strands. This is corroborated by an examination of the published code. We find that 200,000 circular mils stranded conductor is allowed 200 amperes, or one per 1,000 circular mils, and that a No. 0000 solid conductor of 211,600 circular mils is allowed 210 amperes, or very nearly in the same ratio. There may be advantage in using the cable form; but it is doubtful.

Prof. Forbes, at one time, seriously proposed the use of flat strips for underground conductors, but he overlooked the fact that large surface means great increase in cost of insulation. In those days the wires were buried in the ground without the use of conduits, a condition very unfavorable to active convection. We can all remember that but a few years ago conduits were not ventilated except as

the manhole covers, from time to time, acted automatically.

All data so far given in this paper are based upon the action of direct current. There can be no doubt that the heating effect of alternating current, especially in large conductors, must be considerably greater than if direct current is used. But I have no information on the subject and will not weary you with speculation.

Electrical Power Plant at Rheinfelden on the Rhine.[1]

Prominent among the rivers which present conditions favorable to the erection of electrical power plants is the Rhine, and particularly that part of it which extends from Reichenau to Basle, a distance of 154 miles, in which there is a total fall of 1,120 feet. At Schaffhausen, where there is a fall of 90 feet, the Neuhausen Aluminum Works are already established, and are using all the water that can be diverted from the falls without destroying their picturesque beauty. Below the confluence of the Aar and the Rhine there is a constant flow of 77,000 gallons per second, and this circumstance, coupled with the fact that the topography of the surrounding country is favorable to the location of factories, and that in a stretch of the river 1½ miles long, just above Rheinfelden, there are three rapids with a mean fall of 23½ feet, determined the location of the great power plant which forms the subject of the present article.

ELECTRICAL POWER PLANT AT RHEINFELDEN ON THE RHINE.—LOOKING UP HEAD RACE.

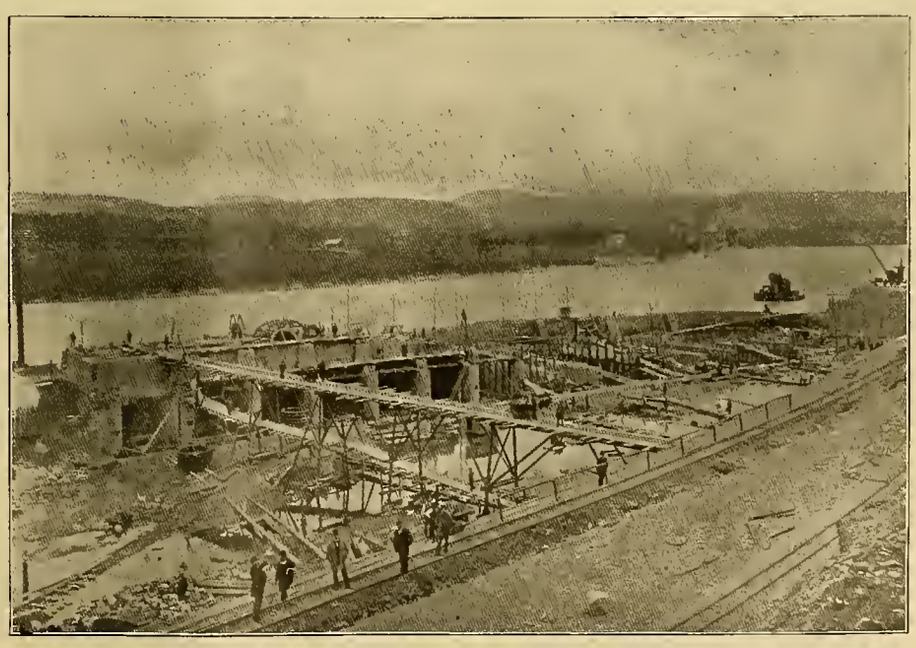
It was originally proposed to utilize the whole low-water head of 25 feet, and the first plans estimated that 11,000 horse power could be realized for an expenditure of $2,500,000. The plans were finally modified by Prof. Intze of Aix-la-Chapelle, and it was decided to use a head of only 16 feet, thereby confining the construction to about 1,100 yards of the river. It was estimated that to secure 15,000 horse power, the cost of turbines and buildings alone, exclusive of the electrical equipment, would be $1,115,000. The contract was let to Escher, Wyss & Co. of Zurich and Zschokke & Co. of Aarau. Prof. C. Zschokke taking charge of the work under the superintendence of Prof. Intze. The electrical plant was built by the Allgemeine Elektricitäts Gesellschaft and the Oerlikon Works.

A plan of the works shows the location of the dam, which is built clear across the river and contains a sluiceway 65 feet in width, the head race which leads the water to the turbines and the power house. The crown of the dam is 6½ feet broad, and while the back of it has a steep angle, the face slopes gently to the bed of the river. The head race is 170 feet wide, the wall on the river side being 23 feet high, five feet broad at the top and 13 feet at the base. The entrance to the head race is protected by screens to keep out rocks, boulders and rubbish. Here also are located the gates which regulate the flow of water. The sides of the head race are lined with brick and cement. A sluiceway, 20 feet wide, is provided on the right-hand side of the turbines for letting out the ice from the front of the screens in winter time.

The power house has 20 chambers, although only 10 of the 840 horse power turbines are at present installed. The chambers measure 18 feet by 33 feet by 49 feet high. The partition walls are four feet in thickness. Each chamber is supplied with a balance gate nine feet wide by 16 feet high for shutting off the water. These gates are moved by a hand-wheel in the dynamo room, which is situated above the turbine chambers. The gates are built to withstand a pressure of 70 tons. When repairs are necessary, bulkheads will be put in above and below the turbines and the water will be drawn off by electrically driven pumps.

As a result of the large quantity of water, 3,740 to 5,500 gallons per second, which passes through each turbine, they all had to be built with a large diameter and to operate at a slow speed of revolution. It was decided to run the turbines at 55 revolutions per minute, and the design adopted was the Francis reaction turbine, with two turbine wheels superimposed. The wheels, which are seven feet 8½ inches in diameter and four feet one inch high, have each 32 vanes, and the guide frames have each 36 blades, the distance between centers of the wheels being 11 feet.

The lowest guide frame, which rests on a bearing ring cast into concrete, conducts the outflow of the lower half of the turbine to the tail race. A wrought-iron receiver rests upon this guide frame and receives the outflow of the upper half of the lower turbine and the lower half of the upper turbine and conducts it into the tail race. Another wrought-iron receiver on the upper guide frame leads away the outflow from the upper guide frame. Both wheels are carried on a 12 inch shaft, which is held by three 24 inch bearings of of lignum vitæ, which is particularly suitable, on account of its hardness and the large percentage of resin which it contains, for bearings of this kind. The turbines are direct-connected to the dynamos by means of a vertical shaft, which is a continuation of the turbine shaft. This works in a metal bearing carried on a cross frame-work. Regulation is effected by cylinder gates in the lower turbine by means of a four-part gate and in the upper turbine by two independent double gates. When there is a high head of water, the lower turbine is sufficient to supply the necessary power and the upper turbine is entirely cut off. As the water of the river rises, decreasing the head, the lower pair of valve chambers is opened first and then the upper pair.



ELECTRICAL POWER PLANT AT RHEINFELDEN ON THE RHINE.—CONSTRUCTION OF TURBINE CHAMBERS.

The three-phase alternating current system of transmission was adopted, as this was considered to be the most economical for this plant. At present it will be operated at a potential of 6,800 volts, but ultimately, as the demand increases, the voltage will be raised to 16,500. The generators are of the inductor type, with stationary armatures and rotating pole pieces. They consist of two stationary armature rings which are connected both mechanically and magnetically by the outside cover or frame. The rings are built up of laminated plates and carry the coils by means of projecting teeth. The inductor ring is cast in sections and bolted to a massive spider which is keyed on the main shaft. Fifty-five pole pieces of a general yoke shape are carried upon the periphery of the ring.

The generators rest on a floor of concrete immediately above the water tanks of the turbine. The generator shaft, as already mentioned, is connected to the turbine shaft by means of a flange coupling which is welded on the inductor wheel, being keyed to a boss near the center of the shaft. The great size of the generator may be judged from the fact that the outer cast-iron frame is 22 feet five inches in diameter. It consists of four separate castings, each of which has two standards or feet which rest directly upon the cement floor of the engine room. The frame is divided horizontally into two parts, which are bolted together.

The turbine wheels on the lower part of the shaft weigh altogether 35 tons, and the inductor wheel and the upper shaft weigh 20 tons, making a total of 55 tons in all. This, of course, necessitates a very solid support. It consists of two semi-circular castings and is 15 feet in diameter. Its outer edge is carried by an annular bed plate let into a cement foundation on the concrete floor. To save the great waste of power due to the friction of this load, oil is pumped into the bearing under pressure of 350 pounds to the square inch. The oil, which is forced to the inside, runs throught the vertical bearing and keeps it clean. That which is forced outwardly is collected for use again. The normal output of each dynamo is about 720 kilowatts and the efficiency is calculated at 92 per cent. The machines are excited by three 150 horse power rotary transformers. Transformers are also used for lighting the power house and the surrounding grounds. Five of the generators will be set aside for lighting and the other 15 are intended for power and for electro-chemical works. The insulators are built to withstand a working pressure of 16,500 volts. The three large insulators on one side of the pole are for the lighting mains and the three on the other side for the power mains. The mains are of bare copper, and silicium bronze wires of smaller diameter will be used for the telephone wires and testing wires, which are placed below the guard nets. Charge for current for lighting purposes will be about 10 cents as a maximum per unit, with a scale of discount varying from five per cent., if the average demand extends over 500 hours, to 80 per cent. if it extends over 6,000 hours per year.

It is hoped that the construction of this fine plant will transform the district of the Upper Rhine into a manufacturing center of considerable note. The company has acquired considerable tracts of land on both the Baden and Swiss sides, which, it is hoped, will in time be utilized for the erection of its manufacturing plants.

1 From the Scientific American.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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And further this affiant sayeth not.

FRANK FOSTER KENWORTHY.

Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

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The relative rights of a street railway company and a passenger in the matter of transfers was the question submitted by John Jenkins and the Brooklyn Heights Railroad company to Justice Dickey of the Supreme Court of New York for adjudication last week. It appears that on October 14, 1895, the plaintiff received a transfer ticket from the Montague street line to the Fulton street line, dated, and the announcement that it was good for a ride only until 2:40 o'clock. He received it 10 minutes before that time. When he boarded a Fulton street car the 10 minutes had elapsed, the conductor declined to accept the transfer, and when Mr. Jenkins refused to pay his fare the conductor ejected him from the car. Mr. Jenkins was then arrested, but was discharged by a police justice. The counsel for the railroad company said that the reason Mr. Jenkins was arrested was because he had created a disturbance on the car. He commenced an action against the company for $10,000 damages, and it was in dismissing this suit that Justice Dickey said that the company only issued transfer tickets as an accommodation and a convenience to the passengers, and it had a right to make rules regulating the transfer tickets and to limit the time when the tickets could be used. He said the plaintiff was not entitled to ride without the payment of a fare and therefore the conductor properly took steps to eject him. The plaintiff, he said, might have had an action for the recovery of five cents fare, if it had been paid, but he had no right to remain and seek violence.

Municipal ownership in England has been extolled so highly that the intimation that there exists cause for criticism in the action of the advocates of this policy will be a severe shock as well as a surprise to those who have been led to believe that perfection had been attained by English municipalities in the management of their affairs. But the London Electrical Engineer breaks the charm. It says:

There have recently been discussions in one or two town councils in connection with the payment of deputations in search of information as to municipal electric lighting. No doubt the agitation at this season of the year is mostly prompted by electioneering considerations, but, nevertheless, it loses none of its absurdity. To say—as one councillor said—that, after they had spent all that money, the committee were as ignorant as they were before, is an imputation of imbecility which makes us wonder what body of voters could fail to detect it. As regards the principle of the thing, if one does not intend to profit by one's neighbors' experience and mistakes, then by all means do away with deputations. But when business men try to conduct municipal affairs without detriment to their private business, it is childish to suggest that they select Saturday for visiting other towns on purpose to have a week-end at the seaside. The experience which they undoubtedly gain is used for the benefit of their town, and is remarkably cheap at the price which is usually paid for it—namely, bare traveling and out-of-pocket expenses.

Can it be possible that English officials resort to such measures? Perish the thought! No doubt an investigation would disclose the fact that Yankees had crept into the town councils and succeeded in bringing these bodies into ill repute.

American street railway men, especially those interested in the use of storage batteries, will be interested in the experiments at Zurich and Remscheid, which have been described in a paper by Ludwig Schröder before the Elektrotechnischer Verein. The battery was used as an auxiliary, and the experiment of connecting it directly across the terminals of the dynamo without using an automatic cell was successfully tried. The current and voltage curves which were taken showed that the output of the generators varied between 72 and 102 amperes in the dynamo circuit, while the line fluctuated from 20 to 210 amperes. The voltage on the line circuit was quite constant, the maximum variation being between 535 and 560. The battery has been in service 2½ years, and for nine months has been connected directly to the dynamo terminals. The coal consumption has decreased to 3.9 pounds per car-mile. On the Remscheid lines there are some heavy gradients, and in a total length of 6.8 miles there is only 180 feet on level roadbed. Motors in 40 manufacturing establishments are also connected to the line circuit. The power station equipment consists of three boilers working at 120 pounds pressure, four McIntosh-Seymour 160 horse power engines and four 100 kilowatt generators. To meet the increased demand for power for factories, a storage battery was installed consisting of 250 Hagen cells having a capacity of 648 ampere-hours, with a rate of discharge of 216 amperes. The four compounded dynamos were connected as shunt machines in parallel with the battery, and a booster designed to give 600 amperes at 100 volts was placed in series with it. The battery is credited with having effected a wonderful saving.

An alderman of the city of Manchester is reported by an English contemporary to have said that "it was a mistaken notion to suppose that Manchester was the home of engineering," yet that is the common belief in England, and it will probably require more than the assurance of this city father to convince the English people that they are far behind the times. The remark just quoted was made by a member of the committee appointed by the City Council of Manchester some time ago to visit Germany and Austria and investigate the engineering professions, the technical educational institutions and the terms of apprenticeship of those countries. On their return, one of the aldermen, speaking of the comparative intelligence of the English and German artisans, said: "In England our workpeople are only about half savages compared with the intelligent artisans of Germany;" and another member of the committee admitted that in all the electrical installations he had seen on the Continent the engines and apparatus were of foreign manufacture, and he had never beheld finer engines anywhere than he had seen abroad. A member of the Amalgamated Engineers, who accompanied the party, said that before his visit to the Continent he had always maintained that England could make the best engines and dynamos, but he had come back with an altered opinion, and was bound to admit that he had seen work in Germany and Austria which would put to shame a great deal of the work done in England. It is evident from these brief extracts that many intelligent Englishmen are awakening to a realization of their true position. If they desire to add to their information and pursue their investigations until they are in position to take a comprehensive view of the situation, they should send a delegation to this country to make an examination here and prepare an unbiased and unprejudiced report.

Those who fondly imagine that the application of electricity to the operation of trunk lines is near at hand may be disappointed in the utterances of Dr. Hutchinson before the New York Railroad Club, which are reproduced elsewhere; but his views should be carefully considered. His conclusion that the improvements and advancements made during the last 15 years had not materially advanced the electric motor in this branch of the service will not find many supporters among progressive railroad men, although it must be admitted, on the other hand, that many of the claims made for the electric locomotive in connection with trunk-line service are absurdly extravagant.

Dr. Hutchinson pronounced the experiment of the New Haven system as trolley service on a large scale and would not admit the possibility of a modification of this plan being adopted upon steam trunk lines. The speaker criticized the officials of the New Haven road for their attitude upon the question. "I think a great deal of harm has been done by the indiscriminate laudation of this third-rail system. It has created an impression on the minds of the public generally that electricity is applicable to any kind of a steam line. In one case particularly that I know of, this loose talk was the cause of a loss of nearly $150,000. The people in question had gone to the expense of developing a water power plant for operating an electric road under conditions that were utterly unsuitable for electric service. I was sent out to examine it, and advised them to discard all their electrical machinery and use steam locomotives. The head of the enterprise told me that he had been led to the adoption of electricity by the fact that the New York, New Haven and Hartford road was using it." We hope that Dr. Hutchinson is not so foolish as to hold the New Haven officials responsible for the blunder of his clients.

National Electric Light Association Will Meet in Chicago Next Year.

At the meeting of the executive committee of the National Electric Light association, held in New York on Monday, President Samuel Insull of Chicago, Vice-president George R. Stetson of New Bedford, F. A. Gilbert of Boston, John A. Seely of New York, W. McLea Walback of Montreal, George A. Redman of Rochester, A. J. De Camp of Philadelphia, E. H. Stevens of Elizabeth, N. J., and W. Worth Bean of St. Joseph, Mich., were present, as well as ex-Presidents James I. Ayer and E. A. Armstrong. George Urban of Buffalo was also in attendance. After some discussion it was decided to hold the next convention of the association in Chicago in May or June, leaving the exact date to be selected by the president.

Next year's convention will be the twenty-first held by the association and the third in Chicago. The organization was formed in this city at a meeting held in the Grand Pacific Hotel on February 25, 1885. Four years later, when it had grown to be a large and important society, it again visited Chicago, and the convention of that year, in the old Exposition building on the Lake Front, with its attendant display of electrical apparatus, was a very successful one, with a large attendance and much enthusiasm. After a nine-year interval, Chicago will again be the scene of the association's annual meeting, and while it is too early to make predictions, there is no risk in saying that the committee will in negotiation for some time.

New Management for the Walker Company.

On January 1st the business of the Walker company of Cleveland will pass into the hands of eastern capitalists who have purchased the property. The new owners include ex-Governor R. P. Flower of New York; Anthony N. Brady, the street railway magnate of Brooklyn; J. W. Hinkley, president of the United States Casualty company, and others. It is rumored that the company will be consolidated with the General Electric company or with the Westinghouse company, but this is denied by representatives of the latter corporations. The Walker company has a stock and bond issue amounting to $5,000,000, and is a large manufacturer of electrical machinery, particularly for street railways. It has been notably successful in the export trade. The officers are: President, J. W. Hinkley; vice-president, Sidney H. Short; treasurer, F. W. Ferguson; manager of sales, H. McL. Harding. It is said that the list of officers will remain unchanged, for some time at least. The purchasers of the stock have been minority holders, and the deal has been in ngotiation for some time.

Chicago Edison Club.

About 90 gentlemen sat down to the bi-monthly dinner of the Chicago Edison Club (which is composed of department men of the Chicago Edison company) at Metzger's Restaurant, on November 18th. President Insull, Controller Anthony and General Superintendent Ferguson were present. Dinner was served at 6:30 p. m., and afterward W. G. Carlton read a paper on "Electrical Work at Niagara," followed by one on "Steam Piping," prepared by C. G. Y. King. Mr. Ferguson gave an informal talk on the three-phase system of alternating current distribution, pointing out its value in supplying outlying districts in cities from a centrally located power station. The meeting proved to be both pleasant and profitable.

Trolley Conduit Railway in a Flood.

The behavior during flood times of an electric street railway operated on the open conduit trolley system, such as the Metropolitan Street Railway company of New York is so extensively laying down, is of interest to the public. While no flooding of the conduit has ever occurred on the Lenox avenue line in New York, it has been averred that, if it were flooded, traffic would necessarily stop, owing to short-circuit, until the water had been run off. That this has not been the case in practice is shown by an interesting experience on the line of the Metropolitan Traction company in Washington, D. C.

On October 9, 1897, as the result of a heavy rainstorm, a stretch of track some 150 feet long on the F street line became completely flooded, the water filling and overflowing the conduit, as it was unable to run off by the usual sewer connection, which was cut off. According to the statement of Mr. Weaver, president of the road, although the conduit was completely filled with water for nearly two hours, the station was not short-circuited, nor were the water rheostats called into requisition. The normal load of the feeder for the section is 300 amperes; the load during the time the conduit was flooded was 600 amperes, and the cars were also operated on the sections on both sides of that which was under water. The water was practically pure, and this partially accounts for the small additional load.

The Washington electrical conduit system, although its conduit had been several times flooded, has never yet been tied up, it is said, except once when the water almost covered the floors of the cars and flooded the motors. At other times the line has been operated by means of a reducing rheostat. The present instance is the only one in which the flooded section has been operated directly from the generators without reducing medium. It was estimated that the pressure of the current on the cars in the center of the flooded portion was about 250 volts.

Lake View Central Station Sold to the Chicago Edison Company.

The central station plant of the Western Light and Power company at 660 Lincoln avenue, Chicago, recently illustrated in the Western Electrician, has been sold to interests which are understood to represent the Chicago Edison company. The capital stock of the corporation, amounting to $100,000, was transferred to a syndicate headed by John J. Schayer, who, the Chicago Record states, has been an agent for the Edison company. Negotiations with Max Eichberg, president and principal owner, have been pending for several weeks, with the result that he released the property at terms which are said to place the purchase in the neighborhood of $300,000.

The company is in exclusive possession of the electrical illuminating field of Lake View and operates under a 50-year franchise covering the entire township. The grant was made in 1886 by the Town Board, consolidation with the city of Chicago not having been effected at that time, and is the only one of its kind in existence. Mr. Eichberg became interested in the property in 1890, purchasing from the Thomson-Houston company the plant of the Lake View Electric Light company, the former corporation having secured possession through foreclosure proceedings. The plant was small and the equipment inadequate, while the franchise was not particularly valuable. The Western Light and Power franchise was then controlled by other interests, which had obtained it from the Town Board, and the grant was acquired by Mr. Eichberg for about $60,000. The plant was rebuilt and equipped with later improvements for electric lighting, while the overhead system of wires was extended through the township. The growth of business required an enlargement of the power house, and in its present state the plant is well built and efficient. Nothing of the original plant remains.

It is stated that the gross earnings of the property are about $49,000 a year and the expense of operating about $30,000, leaving net earnings of $19,000, which, after deducting $6,000 for bond interest, amounts to 13 per cent. on the capital stock. The basis of purchase is said to be about six per cent.

Telegraph in Spain.

The twenty-fifth anniversary of the formation of the Direct Spanish Telegraph company was commemorated on November 6th by the officers and employes at the London office. The event recalls the fact that on December 31, 1872, communication was first established between the Lizard and Bilbao; but, owing to the Carlist war, it was interrupted from August 18, 1873, to May 5, 1874, when the cable was diverted from Bilbao to Satander, and communication was not restored with Bilbao until April, 1876. The Marseilles-Barcelona cable was laid in 1874. When the cable was first opened the Siemens polarized relay was used, but owing to the prevalence of strong earth currents, resort was made to mirror working. The Allan Brown relay was then adopted, doing away with mirror working. In March, 1881, underground cables were laid between the Lizard and Falmouth, to enable direct working thence to Bilbao. On January 1, 1883, communication was established between London and Bilbao, also between London and Madrid, a distance of about 1,300 miles; this being the longest Morse circuit in practical daily use from London. In May, 1884, a new cable was laid between Bilbao and Kennack in Cornwall, and since that time communication with Spain has been uninterrupted with one or two exceptions. In January, 1891, owing to great increase of traffic, the system was duplexed, and additional offices opened, and in January, 1895, Liverpool and Manchester were added to the list of the company's stations.

Sale of Storage Battery Road Confirmed.

Judge Showalter on Friday, November 19th, entered an order confirming the sale under foreclosure of the Englewood and Chicago electric street railway October 12th.

Before entering his order Judge Showalter listened to a strong protest against it. Attorney Frederick R. Babcock of the firm of Winston & Meagher and William Burry of Runnels & Burry, representing holders of unsatisfied claims against the Englewood and Chicago property, and Levy Mayer, representing the reorganization committee, composed of Alfred S. Heidelbach, Samuel R. Shipley, Jules S. Bach and Isaac L. Rice, engaged in a heated debate, which lasted four hours.

The opposition to the sale was based on two points, the principal contention being that the upset price of $250,000 fixed on the property was altogether too low, considering the fact that the court had authorized $325,000 worth of receiver's certificates, all of which, with the exception of $16,635, were issued. The road was purchased by the reorganization committee on a bid of $260,000, and after legal fees and expenses were deducted from this amount there was left only sufficient to pay 71 cents on the dollar of the face value of the receiver's certificates issued. Though most of the certificates were originally taken or later bought up by the reorganization committee members, there are now about $8,500 of them held outside of the committee and about $35,000 of claims against the property still unadjusted, but provided for by the certificates.

The authorization of receiver's certificates is generally regarded as the assurance of the court that the property against which they are issued is worth at least enough more than the amount of the certificates to return for them on sale 100 cents on the dollar. Rarely is the upset price fixed upon a property in a foreclosure sale less than the amount of the receiver's certificates issued, though in this case the upset price was more than 20 per cent. less than the amount of the certificates, without allowing anything at all for a large bill of legal expenses which had first to come out of the proceeds of the sale. Further than this, a good percentage of the proceeds arising from the sale of certificates went into the completion and equipment of the Englewood and Chicago property, and the property when it was sold represented money thus invested in addition to its value before the receiver's certificates were authorized.

Telephone News from the Northwest.

[From the Mioneapolis correspoodeot of the Westero Electrician.]

The Wisconsin Telephone company has announced a 20 per cent. reduction in rates at Menomonie, Wis., from January 1st. The city recently granted a franchise to J. E. Keelyn for an opposition company.

A. T. Hess, a director in the Mutual Telephone company of Des Moines, Ia., has sued the company to prevent a loan of $15,000. This company is just getting its exchange in operation and has over 1,000 instruments in position. Hess claims that the company is being wrecked by the management and is incurring more debts than the articles of incorporation warrant.

The opposition to the request for a franchise by the American Telephone and Telegraph company at Duluth, Minn., has been strong and the demands of the council so burdensome that the company has withdrawn from that field and will seek a franchise in West Superior, Wis., and not attempt to do business in Duluth.

The F. E. Bell Telephone company has completed the extension of its lines to Lodi, Wis. This company will extend to other points in the spring.

The Rocky Mountain Bell Telephone company has completed connection to Gaylord, Mont.

The Ottumwa Telephone company of Ottumwa, Ia., has been incorporated with $40,000 capital stock, and has begun work on its system. The wires in the down-town district will be underground. The company is rushing work to the utmost limit and expects to have the system in operation by January 1st.

The long-distance telephone system, which now barely touches the upper peninsula of Michigan, is to be extended to Escanaba, Mich., and later to Ishpeming and Houghton.

The Wisconsin Telephone company announces that it will probably make long-distance connection with Ashland, Wis.

The Wisconsin Valley Telephone company has awarded the contracts to construct lines to New Richmond from Shell Lake, Wis., and also to Superior. Work has been begun.

J. E. Tomlinson of the Iowa and Dakota Telephone company has been at Vermillion, S. D., looking over the territory with a view to establishing an exchange there.

C. L. Vaughn will put in an exchange in Churches Ferry, N. D., if sufficient business develops.

A telephone exchange will be installed at Brookings, S. D., at once.

The Harrison Telephone company has received its switchboard for the Rapid City, S. D., exchange, and will shortly put in the instruments.

Glencoe, Minn., complains that the Northwestern Telephone Exchange company will not allow messages from the Western Union lines to be transferred to its system at Carver, Minn., though the toll be paid. As Glencoe has not through telephone connection with the Twin Cities, this is an annoyance to those in that city who desire to reach the Twin Cities.

The long-distance telephone system will shortly connect with Glenwood, Minn.

The Forman Telephone company of Forman, N. D., is an applicant for a right-of-way through Richland county, North Dakota, to reach Wahpeton. The county commissioners are disinclined to give the permission.

American Street Railway Association.

Some delay has been occasioned in the publication of the proceedings of the Niagara Falls convention of the American Street Railway association, but the distribution of the report will be made upon December 10th. The stenographer's trunk, containing the report of the convention, was on the train which went into the Hudson, and it required considerable labor and expense to reproduce the transactions.

Swiss Power Transmission Plants.[1]

By Wilfrid L. Spence.

The town lighting supply station at Zürich and Neuchatel are typical cases of single-phase plant. The demand in the former place having outgrown the supply, it is eked out by a motor alternator (and not, as has been frequently stated, by a rectifier) and battery plant at the remote end of a feeder. At Neuchatel the alternators are especially arranged for running, if desired, at some future time as two-phase machines. Baden and Chevres (city of Geneva supply) are excellent examples of two-phase machinery, the distribution being purely two-phase alternating in the former and hybrid in the latter. Three-phase plant is exemplified on a large scale for long-distance transmission at Oerlikon and at the Zürich works of Escher, Wyss & Co. Single-phase transmission for power purposes is not used to any very considerable extent, and it will not be considered further, although it has been stated that the memorable experiments at Frankfort were originally intended to be with this class of machine, and only by the accident of having a three-phase generator at hand was a polyphase current employed.

The works of the Maschinen-Fabrik Oerlikon are largely driven by electrical power obtained from Hochfelden, distant nearly 14¼ miles. Three-phase current at 50 periods is generated at 86 volts, and after transformation to 13,000 volts is transmitted over a line consisting of four wires placed symmetrically at the corners of a square of 19¾ inches side at a height of about 25 feet above the ground. The four wires, of which one is spare, are carried on oil insulators; each wire is four millimeters (0.158 inch) diameter, the material copper, and the resistance 31 ohms. At Oerlikon, the current, after being reduced in pressure to 190 volts, is distributed to induction motors, some of which are started by directly switching on the full pressure without resistance; other motors are furnished with slip rings, and have three-circuit starting resistance and switches to correspond. The line loss is given at 7.5 per cent. of the initial high-tension voltage with 18 amperes per phase. This apparent load of 400 kilowatts furnished by two of the three 200 kilowatt hydro-electric generators running at full load corresponds to an actual net load of 310 kilowatts on the low-tension secondary at Oerlikon. The efficiency of the step-down transformers is not stated, but taking into account their size and the space occupied by the insulation necessary for 13,000 volts, it will probably not exceed, say, 95 per cent., and on this assumption the power factor appears to be slightly over 87 per cent.—namely, ratio of apparent to true watts on the high-tension side at Oerlikon. This is undoubtedly a high result, and it is attained by the extensive use made of synchronons machines, there being one such motor of 170 horse power and another of 80 horse power, and in addition a steam-driven alternator of 65 kilowatts, over-excited, and run in parallel with the power circuits, but doing little or no other work than acting as a phase controller.

With such a long transmission line as 14 miles, it might be expected that there would be a very considerable amount of self-induction to compensate, but this does not appear to be the case. The Maschinen-Fabrik Oerlikon states that the "effect of induction on the line is not of importance, and can be neglected;" hence it would appear that the reduced factor is entirely due to the induction motors, some of which will always be running lightly loaded. It is noteworthy that the lighting and power circuits at Oerlikon are kept distinct, the bulk of the lamps being fed with continuous current. There may be a special reason for this, as the hydro-electric power available is inadeqnate to run the whole works, steam auxiliary plant being regularly in use.

Just here it is interesting to make a rough calculation of what could be accomplished with a high-tension continuous current over the same 14 miles of line and using the same amount of copper. The basis of comparison, if not scientifically accurate, is an eminently practical one. The commercial transmission efficiency may be put thus: There are two 200 kilowatt generators running together fully loaded at Hochfelden, and affording a net load of 310 kilowatts on the secondary at Oerlikon. For direct-current transmission the three active line wires, having each a resistance of 31 ohms, will be combined into two of equal section, affording a complete circuit with a resistance of 19.4 ohms. The efficiency of two direct-current transformers to give a combined output of 310 kilowatts on the secondary will be 93.5 per cent., so that 331.55 kilowatts must be delivered as high-tension current. This leaves 68.45 kilowatts as the line loss, corresponding to a current of 40.69 amperes, to a primary generating pressure of 9,830 volts, to a line drop of 1,631 volts, and to a terminal electromotive force of 8,149 volts. Present experience with high-tension commutators goes to show that these pressures, while undesirable on a single machine, would be perfectly practicable if divided over two with the neutral connection earthed. This is a remarkable result, as the direct current primary pressure is fully 35 per cent. less than that actually used with the three-phase current.

Another instructive example of three-phase transmission was seen at the very fine and extensive Zürich works of Escher, Wyss & Co. The hydro-electric power house is actuated at Zufikon, Bremgarten, distant about 12½ miles. There are four alternators of 224 kilowatts each, driven by a 325 horse power turbine. Three-phase, 50 period current is generated at 5,000 volts and distributed in several directions, some 80 horse power each going to Oerlikon and Wohlon, 60 kilowatts to Sebach, about 250 horse power to a flour mill in Zürich, and about 400 kilowatts to Messrs. Escher, Wyss & Co. The Zürich line consists of two three-wire feeders, each conductor being of copper 7.7 millimeters in diameter carried on double-shed porcelain insulators. The actual resistance of each wire is not known to the anthor, but it shonld be about 7.85 ohms. The conductors are symmetrically arranged three on each side of the post on the same number of cross-arms, the distance, both vertical and horizontal, between contiguous wires being 17¾ inches. The normal maximum load during the daytime is about 400 kilowatts, and the line loss about 15 per cent. The load consists entirely of induction motors, many running more or less light, hence the power factor is only 75 per cent. As at Oerlikon, a synchronous motor is run continuously to compensate for the lagging current. In this case, however, the machine is a very large one, the three-phase armature being wound for 210 volts and 500 amperes at a speed of 750 revolutions, and it runs absolutely without external load so as to secure the best regulation. The cost of this machine, with starting and synchronizing gear, was about £480, or only £2 13s. per kilowatt, the speed being very high. Here also the lighting is carried out with direct currents on a three-wire system, it being considered undesirable to have lamps on the motor circuits. During the summer the direct-current lighting machines, aggregating 60 horse power, are driven by a three-phase motor, but in winter larger generators are required, and they are then run by a steam engine.

Again comparing with a direct-current transmission. Three of the 7.7 millimeter wires, each 7.85 ohms resistance when combined into two, will give a circuit resistance of 10.46 ohms. Allowing a total loss of 36.25 per cent. (corresponding to 15 per cent. line drop and a 75 per cent. power factor) it is found that with a primary generating pressure of 5,000 volts a current of 173 amperes can be transmitted, giving a net power of 550 kilowatts, available on the high-tension side at Zürich. This, of course, is very largely in excess of what is now actually obtained.

Two-phase transmission is not, so far as the author is aware, used in Switzerland over any long distances.

The Baden plant, installed by Brown, Boveri & Co., is an excellent example of two-phase apparatus. The generators are each composed of two electrically and magnetically independent single-phase alternators of what is known in this country as the Westinghouse type. In appearance they are almost identical with the two-phase generators subsequently exhibited by that company at Chicago. Each half machine is independently regulated, and the several alternators are paralleled in the power house. The frequency is 40 periods and the voltage only 1,000, the town feeders being barely a mile long, while Brown, Boveri & Co.'s feeder is only five-eighths of a mile in length. In these works power is distributed at 115 volts by two-phase induction motors driving principally short lengths of shafting. These motors, running up to 30 horse power, are started without resistance, but also without load, by means of a slack belt gear. Some smaller motors are started indifferently with or without load and without resistance, but all machines on public supply circuits must be provided either with a reducing transformer, or preferably with slip rings, and an appropriate starting resistance for the rotor circuit. The latter disposition is the better one, as motors get under weigh with full load torque without taking more than the normal full load current. The crane motors in these shops are all three-phase machines running with the very low frequency of 13 periods per second. Current for them is furnished by slip rings on a two-pole direct-current machine coupled to a two-phase induction motor, an arrangement, as will be seen, which removes from direct connection with the main circuits those motors most liable to frequent starts, stops, reversals and variations of load. The main shop motors are, of course, run continuously during working hours. The factory lights are principally tapped through special transformers on the town feeder, only a few being fed from their own power circuit. Brown, Boveri & Co. wish it to be borne in mind in connection with this plant that it was designed and laid down in 1892, a fact which will account for the divergence from modern practice in several of the details.

Perhaps the finest example of hydro-electric work in Switzerland, and certainly one of the most well considered, is the station at Chevres, on the Rhone, supplying Geneva with two-phase, 45 period current at 2,500 volts. The distance is not great, being about 3¾ miles, with an underground transmission line composed of four conductors, each 0.76 square inch in section. The generators are simply two single-phase machines of an inductor type superposed on a vertical shaft. Each phase is regulated independently, and the alternators are to be paralleled in the power house. The general arrangement of these dynamos is rather good in that a considerable fly-wheel effect is obtained without undue weight on the shaft, and to the extent that there is no moving wire it appears preferable to the Niagara design, which would not in any case have answered at Chevres, because current suitable for lighting is a prime necessity. In passing, it may be noted that these machines give considerably less electromotive force than was anticipated, and the difference is made up by boosters—"survolteurs." At the receiving end in Geneva there are several systems of distribution. One, a three-wire direct-current supply at 2×110 volts; another, an alternating network at the same pressure; a two-phase power circuit at 500 volts, also used for street lighting; and fourth, the trolley system, direct current, at 500 to 550 volts. The first and last of these are fed through rotary converters, made by the Alioth company of Munchenstein, Bale, and it is noteworthy that, notwithstanding the independent control over each phase at Chevres, the constancy of pressure at Geneva was greatly increased when these rotaries were started up. Unfortunately, owing to the stoppage of the Chevres plant since the close of the exhibition, the experience with these converters has not been very great, but Col. Turrettini has informed the author that the working of the 2×110 volt lighting machines was not attended by any sparking, and they are believed to have been entirely satisfactory. These rotary converters are really very fine specimens of their class, and appeared to be thoroughly well designed and put together. A description of one of the two types—that with a Gramme armature—has been published in this country, but the larger machines, with drum armatures, have not previously been described. This latter form is preferred by the Alioth company, who have very kindly placed the following particulars at the author's disposal:

The machine takes current at 360 volts alternating on the slip rings from two 80 kilowatt transformers—one for each phase, at a speed of 338 revolutions per minute, delivers 560 volts and 268 amperes at the commutator brushes. The armature is 34¼ inches diameter by 11¼ inches long. There are 320 slots, and the same number of coils and commutator bars. The winding is of copper wire 2.5 millimeters diameter. The armature weighs 6,400 pounds, and carbon brushes are used. The magnet yoke is of cast-iron, carrying 16 steel limbs and pole-pieces, and absorbing 1,150 watts for excitation. The complete machine weighs 26,000 pounds. It is started by a regulating transformer of only five kilowatts, used, however, as a reducer, the starting current being slightly in excess of that at full load, and the requisite electromotive force only 12 volts or so.

The method, while evidently very efficient from the point of view of regulation, is obviously no royal road to overcoming loss on the line. Between light load with its lagging current and heavier load with its leading current there is apparently only one point where the power factor becomes unity, and then only are generators, line, and converters working individually and collectively at their best, or at what should be their best. At all other times the losses must be considerably greater than correspond to the work done. This particular method is not, so far as can be learned, in use in Switzerland at present. Any required variation on the direct-current side is there obtainable either by regulation of the static transformers, which reduce the line pressure 2,500 volts to 360 volts for the slip rings, or by boosters on the primary. Other analogous arrangements are possible, and, in the author's opinion, preferable to compounding, which, however, is simple and automatic.

Reverting now for a moment to the claims already enumerated which have been advanced for polyphase power transmission plant. At Hochfelden (Oerlikon) the three-phase dynamos comply with the claims; they are relatively small and inexpensive, are highly efficient, generate at a low pressure, which is transformed without difficulty to a very high one, and but for the inductive load would have a small pressure drop. The line, for reasons stated, does not show the 23 per cent. economy in copper which the three-phase system is supposed to effect over a direct-current line. The motors at Oerlikon are doubtless quite satisfactory. Their use, however, entails a low power factor (reducing the available horse power some 13 to 15 per cent.). This reacts on the generators, and tends to cause a pressure drop of 15 per cent. or so, which is compensated at the cost of larger machines. At Bremgarten (Escher, Wyss & Co.'s) the same remarks apply to the generators and to the line. The motors are not quite so simple as claimed, being, in fair sizes, started with resistance in the rotor circuit. Their general use at all sorts of loads causes a very low power factor, not greater than 75 per cent. At Baden (Brown, Boveri & Co.'s) the two-phase alternators do not comply with any of the claims made for polyphase apparatus, but their construction does make it practicable to operate motors and lights together. The line has none of the advantages pertaining to polyphase circuits, the power and lighting feeders being distinct. The factory motors in medium sizes fulfill the claims, but are started with a slack belt gear. At Chevres (Geneva) the foregoing remarks apply to the alternators and to the transmission line.

With regard to lighting, it seems to be generally admitted that in connection with induction motors running under variable load, really good results cannot be obtained at all on the three-phase system. If lamps must be connected to the motor circuits, then a four-wire lighting distribution, supplied, if possible, by a separate feeder, should be used. With a two-phase system and single magnetic current

1. From the London Electrical Engineer.

generators the same remarks apply. A practicable result is obtained with independently controlled phases, but even then separate feeders are most desirable, and at the best one circuit—say, the lighting—is closely regulated at the expense of the other—the power circuit. In all cases where the transmission line is a long one, synchronous motors, or their equivalent, are essential at the receiving end.

It may be objected that in each of the three examples—Oerlikon, Zürich and Baden—the plant is not of the most modern design, and that with maturer experience the generators and transformers could be constructed with a smaller drop, and the motors with smaller air space and less magnetizing current. This may or may not be valid, but it remains that those who have had most experience consider that alternators with a potential drop of four to five per cent. at the lamps and about 15 per cent. at the motors are about as good as can be made.

Having said so much about the system generally, it is due to add that from the factory manager's point of view two and three-phase motors are perfectly satisfactory. Not too much need be made of starting under load and without resistance, because the same claim can be made for direct-current shunt motors, and because in neither case is this allowed on public supply circuits. The satisfaction arises more perhaps from the perfection of accessory details. It was noticed at Brown, Boveri & Co.'s that small motor spindles were case-hardened and ground true. The bearings, it goes without saying, are self-oiling. The worm reducing gear as turned out by the Maschinen-Fabrik Oerlikon, and, doubtless, by others since, is a most excellently arranged mechanism. Its efficiency, which is remarkably high, is partly due to the ball thrust bearings, and partly, it is claimed, to high surface speed; but however arising, the success is undoubted, and more than sufficient to cover the multitude of sins attributable to high rotative speed. This gear is in almost universal use, not alone with induction motors, but also with direct-current machines on overhead travelers, and one of the most pleasing features in all works visited was the favor with which the arrangement is regarded. It is almost unnecessary to add that no one-motor cranes were seen.

The author's conclusions with regard to polyphase plant are as follows:

(a) As exemplified by the two long-distance transmissions named, three-phase plants involve very much higher line pressures than would be necessary with a practical direct-current constant-potential equipment under like conditions.

(b) Three-phase transmission at 10,000 volts, with power distribution by inductor motors only, compares unfavorably with direct-current plant at little more than one-half the voltage.

(c) For long-distance transmission a three-phase line has undoubted advantages over any other system, but to realize these it is essential that none but synchronous or non-inductive consuming devices be used—induction motors have no place in work of this character.

(d) The best combination for really long-distance transmission comprises three-phase generators (step-up transformers), line and step-down transformers, rotary converters excited for minimum current, a direct-current distributing network, and direct-current motors. Any regulation on the latter circuit is to be arranged so as not to cause phase displacement on the primary side. This is nearly, but not quite, the Niagara-Buffalo system.

(e) Where a line pressure of, say, 6,000 volts will give the necessary economy, three-phase apparatus is superfluous; a direct-current plant pure and simple will be more advantageous.

(f) For short-distance transmision at or below 2,000 volts, the use of two or three-phase equipment is generally disadvantageous.

(g) English engineer-electricians are to be congratulated on having viewed with some degree of scepticism the plunge made by their continental friends into polyphase work. This type of plant, which is undoubtedly doing good service in Switzerland, has no raison d'être in England. Its development is a result of really cheap water power in some cases, and of supposedly cheap water power in others.

It remains to notice another type of transmission which is peculiar to Switzerland, or, at least, to Swiss engineers—the extra high-tension, continuous, constant current, series system developed by Mr. Thury of Geneva. The general arrangement is well understood and will not now be detailed. The system is best suited for the transmission of power only, and for its distribution in moderately large units. The machines, generators and motors alike are unquestionably very inefficient as compared with English constant-potential dynamos of the same output; but, on the other hand, is the fact that they work direct without any transformation on circuits of 15,000 volts or so. The motors have constant torque and a wide range of speed; the switchboards are extremely simple, because the connections are never opened (only short-circuited); there are no fuses, and the line is of uniform size throughout. The disadvantages are obvious. Each machine has to be mounted entirely on insulators, and can only drive through a leather belt or insulating coupling. A wide wooden platform, also on insulators, is necessary round the machine for safety, and every motor requires an independent governor to control the speed. The system is consequently practicable with main as distinguished from individual machine motors. For lighting purposes it is rather cumbrous, as low-tension current can only be produced by the combination of a dynamo direct coupled to, but insulated from, a motor as above described. The details of governors, automatic short-circuiting cut-outs, switchboards and lightning arresters are well worked out, and seem to give good satisfaction. The system has found considerable acceptance in Italy and Switzerland in competition with polyphase apparatus, but particularly in situations where natural water powers exist but are too far separated or too inaccessible to be unified into one large scheme. These are picked up, so to speak, in series, an arrangement to which the plant readily lends itself.

The Maxim Filament.

Mr. Hiram S. Maxim, the inventor, has written to the London Electrician a letter relating to his experiments with incandescent lamp filaments. It is of interest to American electrical men, although it may be imagined that there are American manufacturers who will take issue with the "four watts per candle" statement. Mr. Maxim says:

"All the reports that have appeared in the American and English press regarding my experiments with electric lamps have come from a single source. An American newspaper reporter came to interview me. He said he had heard I was doing something with lamps. I said: 'It is quite true that I am experimenting, but as yet I have no particulars to give. However, the lamp which is lighting this room, and which has displaced three 16 candle power lamps, is 42 candle power. When this lamp was made it was found to give a candle power for considerably less than two watts, whereas the ordinary lamp takes at least four. I did not believe the lamp would last two hours; however, we put it on, and this was a long time ago and the lamp is still running and is of great brilliancy and quite clean. If I were sure of being able to make lamps like this, in large quantities, the process would be worth a lot of money, but so far I have not advanced far enough to show the lamp to the public. I am running a number of lamps in a large room upstairs, and some have been running 1,000 hours.' As to the lamp in question, when it was put on it was 42 candle power; about two months later it was found to be 52 candle power. However, it has commenced to go off, and when last tested was 41 candle power, which would seem to indicate that it is not going to last forever after all.

"What I have been attempting to do is to produce a lamp in which a very high resistance might be obtained with a short and thick filament, also to produce a filament which will stand a higher temperature than those ordinarily used, as it is well known that a slight rise in the temperature greatly augments the light given in proportion to the current used, but the preparation of the carbon and other materials which form the filament requires a very expensive apparatus. The cost, however, of the finished filament—excepting first cost of plant—is no greater than with the ordinary lamps.

"I have tested the new lamps in competition with all the best lamps I could find, and there is no question but what they show a very marked saving in electrical current, and this, of course, is the object aimed at after all. I have not decided as yet whether to keep the process a secret or to patent it."

Heilmann Locomotive.

Commenting upon the announcement of the test of the Heilmann locomotive between Paris and Nantes, mentioned in the last issue of Western Electrician, and the additional statement in the press dispatches that "the directors have decided to adopt the Heilmann locomotives," the Railroad Gazette points out that the changes that have been made in design and construction have not modified the original idea: "We suppose that every reader of the Railroad Gazette who has any interest in this matter knows too much to accept for a moment the statement that the directors of the Western Railroad of France or any other great railroad will adopt the Heilmann locomotive unless it might be for some very peculiar service. The locomotive mentioned in this cable dispatch is doubtless the new Heilmann locomotive built within a year, and which is modified considerably from the "Fusée" (Rocket) of two or three years ago. It embodies, however, all the essential principles of the earlier Heilmann locomotive. It is a central station and an electric locomotive combined. On 16 driving wheels (eight-coupled at either end) are carred an ordinary locomotive boiler with a Belpaire firebox, and an upright steam engine of from 1,300 to 1,400 horse power, with six cylinders, also two generators and an exciter, and, finally, an electric motor on each one of the eight axles. It goes without saying that such a machine can develop and can sustain great power and speed; but, on the other hand, it also goes without saying that it is an extremely costly, cumbersome and unmechanical way of hauling trains over the face of the earth. This aspect of the subject we discussed at considerable length when the earlier Heilmann locomotive was attracting attention, namely, November 9, 1894, and that discussion was summed up in the following sentence: 'Theoretically, it is wrong; practically, it is too heavy and complicated.' We see no reason for changing that opinion now."

Electricity for Trunk-line Working.

At a recent meeting of the New York Railroad Club the subject for discussion was "The Engineering Side of the Application of Electricity to Standard Railroading." Mr. Potter of the General Electric company, who was to have presented a paper, was unable to prepare it, and the discussion was verbal and informal. Dr. Cary T. Hutchinson, in the course of his remarks, said:

"Something has been said about electricity, but nothing regarding trunk-line conditions. I am of the opinion that the latter is by far the more important side of the question, and if electricity is ever applied to trunk lines it will be due chiefly to changes made in the conditions of the trunk-line service and very little to improvements in electrical machinery. Although the electric locomotives which are built to-day are as far superior to the one shown on the board as is New York Central "No. 999" to the first "Rocket," yet I think that the application of electricity to trunk-line service is no nearer than it was at the time this locomotive of Mr. Edison was built. The electrical appliances have improved steadily, but the trunk-line conditions have become worse, from an electrical point of view; that is to say, freight trains are heavier, express trains run faster and are more numerous, and the entire tendency has been away from conditions favorable to electricity.

"The chief condition for economical electrical service is that the train service shall be frequent; that is to say, that the machinery, including the copper feeders, be always kept loaded, doing work to its full capacity, nearly all the time, instead of two or three minutes out of the hour, as would be the case were an attempt made to run the present trunk-line service with electricity.

"The only place in the country where there is anything approximating to the application of electricity to trunk-line service is at Baltimore, and here the reasons leading to this application were not primarily those of economy. Incidentally the change has proved economical, but the cause for this application was the comfort and convenience of the passengers, rather than any saving in the operation. The locomotives here, as you may know, weigh about 200,000 pounds, and have given on test a drawbar pull of 65,000 pounds, probably as heavy duty as any steam locomotive has ever given.

"This question is not changed materially in my opinion by the use of alternating currents in any form; it is purely and simply a question of keeping the machinery at work all the time and of supplying sufficient track facilities.

"I wish to disabuse your minds of the impression that probably prevails that the work of the New York, New Haven and Hartford on the third-rail system has advanced in any degree this application of electricity to trunk-line conditions. The service given by the N. Y., N. H. and H. is nothing more than a trolley service on a large scale, with heavier cars and higher speeds, and with the trolley wire put on the ground in the form of a third rail. Engineering difficulties have, of course, been met with and overcome, but there is no relation between this work and the topic under discussion. I think a great deal of harm has been done by the indiscriminate laudation of this third-rail system, much of it coming from the N. Y., N. H. and H. officials. It has created an impression on the minds of the public generally that electricity is applicable to any kind of a steam line. In one case particularly that I know of, this loose talk was the cause of a loss of nearly $150,000. The people in question had gone to the expense of developing a water power plant for operating an electric road under conditions that were utterly unsuitable for electric service. I was sent out to examine it, and advised them to discard all their electrical machinery and use steam locomotives. The head of the enterprise told me that he had been led to the adoption of electricity by the fact that the N. Y., N. H. and H. road was using it."

Interesting Instance of Electrical Economy.

The convenience of electric motors for attachment to machinery which was not arranged with a view of their employment is nicely shown in a design worked out some time ago by George Gibbs, mechanical engineer for the Chicago, Milwaukee and St. Paul railway, at the West Milwaukee locomotive repair shop, and described in the American Engineer. The application is to the operation of a walking crane formerly driven by a rope. The crane bears the name of Craven Brothers, Manchester, and has done service for a number of years. The floor carriage is built of I-beams. These beams are covered at top and bottom by iron cover plates, and within the box thus formed the propelling motor was placed.

The mast is also of I-beams carrying a small carriage at its top which forms the upper bearing of the crane and runs along a track formed by two I-beams turned on their sides and extending the full length of the shop. The crane is located centrally between the machine and the erecting floors and it is kept busy a large part of the time. The motor for hoisting is secured to brackets at the top of the mast. The motors have separate controllers mounted on the base carriage and they are very compact, taking up little space.

The motors are of the Gibbs type, known as "F 5,"

and run at 700 revolutions per minute, taking current from overhead wires suspended above the upper rail of the crane. Power is furnished from generators which are always running for other purposes during working hours. Worm gearing is used in both cases, the system of reduction being exceedingly compact and strong, and it is also well protected from injury in operation.

The most interesting feature of the design is not connected with the details of construction, but is the fact that the rope drive could be so neatly and easily replaced by motors. The crane formerly run by means of a cotton rope which was wrapped around sheaves on the top of the mast between the rails, and gearing was employed to traverse the crane and do the lifting. The rope ran at a very high speed and was kept running all day. It was found that the countershaft and rope consumed 12 horse power when running light, and the total power consumed when running the crane at its full capacity was only 15 horse power, which gave three horse power available for doing useful work, a very small proportion. The electric motors are rated at five horse power each. As they were applied with very little change in the mechanism, the work of applying them was not expensive. The hoisting motor required the addition of one gear and pinion and two small gears added to connect the traversing motor to the driving wheel.

Twenty-five Years of Telegraphic Progress.[1]

By W. H. Preece.

There are doubtless many who would argue that had not the telegraph system of this country been shackled by its connection with the state, the actual progress which would have made since the transfer (in 1870) would have been far greater than it actually has been. Whether the argument is a correct one or not matters little, but that a very substantial progress indeed has been made since 1872, the date from which our record is to commence, admits of no doubt whatever. Statistics confirm it most amply. No better commencement can be made than to state the number of telegrams which are recorded as having passed over the postal telegraph wires in 1871-72 and in 1896-97. In the former statistical year the total amounted to 10,207,362, whilst in 1896-97 this total had grown to the large figure of 79,423,556, or nearly an eightfold increase. In 1871-72, the number of offices open was about 3,500, and in 1896-97 this had increased to 8,282 Again, let us compare the line and wire mileages; these in 1871-72 amounted to 21,843 and 94,991 respectively; they now (1896-97) total 41,393 and 279,935.

In 1871-72 the total number of instruments in use was 8,945; in 1896-97 the total number had increased up to 30,132, made up as follows: Automatic, 436; quadruplex, 137; multiplex, 31; repeaters, 131; sounders, 4,735; Morse printers, 739; Hughes, 77; Bright's bell, 952; single needle, 4,714; A. B. C., 5,018; telephones, 8,843; miscellaneous, 4,319.

We see not only a very large increase in the total of apparatus, but we have the introduction of the quadruplex and multiplex systems, which, originated by American ingenuity, have, more especially in the case of the multiplex, been very materially modified in important points of detail, without which their efficiency would have been appreciably less than at present.

Turning now to what is unmistakably an English form of apparatus, viz., the "Wheatstone automatic," in 1872 a speed of 100 words a minute was considered a very respectable achievement; now, 600 words has been practically obtained, although for commercial, and not for electrical or mechanical reasons, 400 words is the practical limit at which working is carried on. A comparison of the mechanism of the apparatus as it at present exists, with the older form, is an instructive study. The present high speed, it may be stated, has been largely due to the inclusion of a "shunted condenser" in the receiving circuit, an arrangement first applied in 1882. As regards the value of the Wheatstone, without its use the enormous amount of press traffic passing over the wires could not possibly be handled.

If we may take elaboration as an example of progress, we have it in the form of the "fast-speed repeaters" used in connection with the Wheatstone apparatus when the latter have to be worked over exceptionally long circuits. The present form of this apparatus, for use on cable circuits, comprises 41 instruments of 26 different forms; it is arranged to work bridge duplex on the cable side, and differential on the land section of the circuit. The value of repeaters for speed purposes may be illustrated by the fact that direct working between London and Aberdeen (560 miles) would not be possible at a higher speed than 40 words per minute, whereas with repeaters at Leeds and Edinburgh the working speed is fixed at 350 words. These repeaters in their present efficient form are an introduction within the last 25 years and are marvelous examples of ingenuity.

The past period of 25 years has witnessed the introduction of the "sounder" into the postal telegraph system to the partial disuse of the Morse inker, although the latter cannot yet be said to have become an obsolete piece of apparatus. In the use of the two forms of instrument the sounder and the inker, this country stands intermediate between America and the Continent. America uses the sounder exclusively, whilst on the Continent the inker is practically the standard form of instrument. A small but important addition to all local apparatus, i. e., apparatus worked by relays, has been the general introduction of a double wound spark coil, or shunt of high resistance, across the terminals of the same; this has resulted in the suppression of the spark at the relay contacts and a consequent greater certainty of action. The improvements in point of detail, which are really of far greater importance than might at first sight be imagined, are practically legion, and can only be appreciated by those who for a long period of time have had the handling of apparatus.

The last 25 years has witnessed the introduction of the Fuller bichromate battery, a type which has done most excellent work; the several types of Daniell cell, which have been used, have, as a result of the "survival of the fittest" law, been reduced to one standard pattern.

The use of currents produced by dynamos has not received acceptance for telegraphic purposes in this country, the actual conditions required for working the circuits practically not admitting of their employment, but a great revolution has come about in the adoption of accumulators in all large offices; the result being a great improvement in working and a saving in maintenance and in space. The use of accumulators has required many matters of detail to ensure safety and reliability of working to be worked out; these, however, have been most carefully and skillfully dealt with by the engineering staff, with most excellent results.

Line construction has made vast strides within the period under review, the old larch pole of irregular section and not over-regular run has given way to the present fine looking fir timber of symmetrical form. Preservation by burnettizing, kyanizing and boucherizing, is a thing of the past, and now creosoting is universal. A line of less than a dozen wires which at the beginning of the 25 years' period would be thought a heavy one is looked on as insignificant now, and several of these lines which at the time they were constructed were thought to afford an ample margin for future wants have had to be entirely rebuilt with stouter timber, in order to afford efficient strength for the greatly increased number of wires that the increase of message traffic, and especially the introduction of the telephone, has necessitated. The use of "H" poles strongly and rigidly bound together with iron stays has become very general.

A new departure in the shape of iron arms, introduced by Mr. Langdon of the Midland railway, in the place of those of oak, has been recently made, and an important line on the Midland railway has been constructed in this manner; the arms being of tubular section are very strong, and at the same time are light.

A marked improvement in insulators was the introduction of the "screw" pattern in 1877, a form which enabled the cleaning of the porcelain to be greatly facilitated, as the cups instead of being cemented were only screwed on to the bolts.

In connection with aerial lines the change which has come about in the description of wire used is striking. In the very early days of telegraphy copper wire was employed, but was very soon abandoned in consequence of its lack of strength, and also, it has been stated, in consequence of its liability to be stolen, though there is no evidence to prove that the last statement ever had any foundation in fact. The employment of galvanized iron became practically universal, and in spite of its inferior conducting power has done excellent service. The continued demand for this iron telegraph wire has resulted in a very great improvement in its manufacture, not only as regards its strength, but notably in its specific conductivity, which has probably been increased more than 50 per cent. within the last 25 years. A bold and costly experiment of erecting a copper wire from London to Newcastle, in 1887, has revolutionized the hitherto universal practice of employing iron wire, and the discovery that for long lines the employment of copper, on account of its low electro-magnetic inertia, was vitally necessary, has led to a great extension in its use, not only for telegraphic purposes but almost universally for telephonic use. The improvement which has resulted in the manufacture of the copper has resulted in the hard-drawn quality now so well known, which has a conductivity exceeding 100 per cent. of the Matthiessen standard. Doubtless the extended use of the metal for telegraph lines has largely been the result of the low price which has so long reigned, a price which, from a telegraphic point of view, it is to be hoped will be maintained. The advantage which copper posseses over galvanized iron (irrespective of the absence of electro-magnetic inertia) is instanced by the fact that an 800 pound iron wire, the largest size which can practically be employed, has a resistance of 6.66 standard ohms per mile, whilst an 800 pound copper wire has a resistance of but 1.098, the minimum breaking strain of the two being very nearly alike, viz., 2,480 in the case of the iron and 2,400 for copper; moreover, the durability of copper is far greater than that of iron.

With reference to the great increase in wires necessitated by increased traffic, it may be mentioned that nearly all the main roads available for the purpose have now been taken up on both sides with lines of telegraph poles, and in view of the still increasing requirements, the problem of a satisfactory system of underground wires has had to be tackled. The actual amount of underground work at present in existence amounts to no less than 942 miles of pipes and 30,058 miles of wire, of which 17,000 miles of wire are within the metropolitan area alone. None of this wire, however, with the exception of a section between Manchester and Liverpool, comes under the category of main line systems; the wire is actually only used for the purpose of avoiding the employment of aerial wires within the limits of a town where the use of poles is impracticable, or rather is forbidden by the local authorities. The introduction of "paper cables" seems likely to materially help towards solving the problem of underground communication, as the electrostatic capacity of these cables reaches a low point hitherto unattainable, and moreover, the item of expense, which has hitherto been a great barrier, is in the case of paper insulation reduced to a minimum. At the present time a paper cable of 76 wires is in progress of being laid between London and Birmingham, and although this cannot be looked upon in the light of an experiment only, still the experience which will be gained will doubtless have a material effect in showing to what extent long lengths of underground work will be advisable in the future.

Turning now to the question of progress as indicated by the extent of plant, workshops, etc., which used to be sufficient for the needs of the postal telegraph service and what is necessary now, it may be pointed out that a small establishment (originally the property of the Electrical International Telegraph company) at Gloucester Road, Chalk Farm, and covering about one acre of ground, was sufficient in 1872 to contain the workshops and stores of the department. Now, the major portion of the land occupied by the old Clerkenwell prison, 10 acres, and a fine factory employing 200 men at Holloway, is taxed to the utmost to keep pace with the requirements of the service. More than 50,000 pieces of apparatus are passed through the mechanics' workshops each year, and this number tends to augment year by year.

It is, perhaps, somewhat invidious to make comparisons, but it is none the less a fact that though we in England have been rapidly advancing in telegraph matters, not only in regard to improvements devised by our own engineering staff (which improvements, though unknown to the public from the simple fact that they are not patented at home nor published abroad, are nevertheless very real indeed) but also in regard to our readily taking up and improving such inventions as have here and there been devised by other countries, yet other nationalities, even the United States of America, have almost stood still, except from the point of view of increase of mileage of wire and of the number of offices opened.

The introduction of the 6d. tariff in 1890 has had, of course, much to do with the increase of volume in telegraphic business, but the able character of the whole engineering staff has enabled this increase to be properly handled, to the general satisfaction of the exacting public, who, as a rule, are not given to praising what is done well by their own servants and who seldom fail to find fault on the slightest provocation.

1. From the London Electrical Review.

Electricity for Balky Horses.

[From the Pittsburg Dispatch.]

Electricity has been put to a new and so far successful use, that of conquering a balky and lazy horse. In one case a very high-spirited and valuable animal, but extremely vicious and balky, was cured in one hour with the aid of a three-volt dry battery.

The officials of the Western Pennsylvania Humane society were notified some time ago that Thomas Rodgers of Avalon was using the dry battery on his horse, which was as bad as a valuable high-bred horse could be. Superintendent Thomas M. Porter investigated the case, and Friday he gave Rodgers a hearing before Justice William Griscom of Avalon. Rodgers said his horse was worth $1,000 if he could be cured of balking and one or two other vicious habits. He had offered $500 to anyone who could manage the animal, and at last consulted Dr. T. C. McNeil, the city veterinary. The doctor advised Rodgers to try electricity, and he bought a three-volt storage battery, and by means of three wires connected each side of the bit and the crupper with the battery. The horse was hitched to a road cart and at first refused to move, standing with all four feet in a braced position. Mr. Rodgers then had the wires connected to the battery, which was placed in the cart, and at the first push of the button the horse jumped, snorted and then moved off. Each day for a week he went through the same lesson, and is now the pride road horse of Avalon and never balks, bites or kicks.

That was the testimony brought out at the hearing, and as the veterinary and squire thought three volts was not a sufficient shock to hurt the animal, Rodgers was discharged.

Superintendent Porter had a similar case some months ago. He found that one of the rich suburban residents was using the fluid battery on a lazy horse in cultivating his summer garden. After several unsuccessful attempts to catch the gardener using the horse, he was at last rewarded by catching

the gardener weeding the potato patch with the horse hitched to a harrow. The superintendent went to the driver and, after introducing himself and informing the man why he visited him, he was shown the contrivance.

Strapped to the backband was a small fluid battery, with wires running from it to the martingale and crupper. A sponge was fastened to the wire at each place and kept moist by the heat of the horse's body. When the animal got tired it would stop, and by pressing two buttons together the circuit was formed, and the horse would move on for several hours. Porter tested the full strength of the battery on himself, and found that the sensation did not go above his elbows and that the voltage was only a fraction over two. He said he thought it was better and more humane to use a small amount of electricity on a horse than to whip it, and was satisfied it was not a case of cruelty. He has written to several of the best-known horse doctors in the United States, asking their opinions on the subject, and is waiting for their replies with a good deal of interest.

Electric Motors for Rolling Mills.

Ernest K. Scott, in a recent contribution to the Iron and Coal Trades Review, says that owing to the extreme variations of load it has generally been considered to be extremely difficult to drive rolling mills by means of electric motors, and this idea has probably been helped because up to the present a ponderous slow-running engine (in some cases the ancient beam engine) has generally been employed for the work. While it is true, however, that the electric motor is essentially a high-speed machine, the experience which has been gained with large multipolar direct-driven dynamos for traction and power work shows that dynamo-electric machinery may be economically built for any speed, even so low as 60 revolutions, and at the same time give ample flywheel effort.

There is no doubt that the motor would have its work cut out if applied to some of the older and heavier rolling mills, on account of the jar and vibration due to the gearing; but with the armature coils sunk into the armature core and thoroughly insulated the difficulty could be satisfactorily met. As a matter of fact, it is not at all clear that the users of rolling mills believe in toothed wheels to the extent they did; for at the Bromford Iron Works, West Bromwich, three sets of double leather belts (the largest a 20 inch on a 22 inch) have been successfully driving heavy pairs of rolls for some considerable time. Of course, with such belt drives the matter, so far as the electric motor is concerned, is quite simple, and the ordinary two-pole type with smooth-cored armature will do very well.

Motors have for some time been successfully used on bending rolls for boiler plates, and the conditions of service in this instance and in rolling mills are very similar. In the case of machines built by the Niles Tool Works the motors are given a speed of 300 revolutions a minute, but this can be varied within wide limits by controllers. The motors are made by the Card Manufacturing company, and are of the steel-clad type with a spring suspension, in exactly the same way as a tramcar motor, which is found to be an advantage, because of its enabling the motor to give slightly in starting against a load. Controllers for this kind of service are frequently made almost as large as the motor; and this is a good point, because being the part which is directly handled by the workmen, it is very liable to be damaged. Not a few of the mishaps which have attended the application of motors, especially reversible motors, to machine tools, winding engines, etc., have been due to the skimping of this detail, for experience has shown that handles and gear which will work very well in a test room, or even in an electric engineering workshop, are apt to have a very short life when in the hands of the ordinary workman, who will break them if he can. Seeing that the breakdown, if it does occur, is blamed onto electrical work generally, it therefore behooves manufacturers to put plenty of metal into those mechanical details which must of necessity be handled by strangers.

In driving the lighter class of rolling plant there is undoubtedly a good opening for electric motors; and when a little experience has been gained in the work, no doubt some of the very heaviest class of rolling mills will also be actuated electrically. That there is room for improvement on present practice is shown by the fact that the large direct-coupled rolling mill engine is very liable to stop on or near the dead centers, or at any rate in such a position that when starting again it cannot exert its full torque. A very much larger engine than is really required has therefore to be laid down; and as it works at low efficiency, its steam consumption cannot be less than six or seven pounds per indicated horse power. With an electric motor there is no dead center, and the engine employed in generating the electric energy may be of the most efficient triple-expansion high-speed type, taking only about 1¾ pounds per indicated horse power.

Another advantage of employing electric power is that the whole of the auxiliary work of moving the live rollers, the elevating and traverse gear and the overhead cranes can be effected by separate motors, all receiving energy from some central point under the most efficient conditions and at a great saving in labor.

Comparative Economy of Direct-connected and Belt-driven Generators.

Very recently the Railroad Gazette endeavored to obtain from some street railway managers and from engine builders information concerning the relative economy between direct-connected and belt-driven generators in electric railroad work, but these inquiries met with no favorable response, inasmuch as accurate tests had not been made. Now, however, such a test has been made at the power house of the Chester Traction company, Chester, Pa. A tandem compound condensing engine built by Robert Wetherill & Co., with cylinders 20 and 36 inches by 48 inches, and designed to run at 100 revolutions a minute, was direct-connected to an eight-pole, 400 kilowatt multipolar General Electric generator, runing at 100 revolutions. The engine was supplied with steam from four horizontal return tubular boilers, burning a fair quality of Likens Valley buckwheat coal, free from moisture. The results of the test, which lasted 17 hours 30 minutes, showed that the coal consumed in pounds per kilowatt-hour was 3.004, and the coal in pounds per engine horse power was 2.242. This test was followed by one on two condensing engines with cylinders 22 by 48 inches, and running at 80 revolutions. These engines were also built by the same company as those used in the other test and were supplied with steam from the same source as the compound engine. Coal from the same source was used in both cases. The boiler pressure was 100 pounds. A Westinghouse compound railroad generator of 225 kilowatts was belted to each engine. The results of this test showed that the coal in pounds per kilowatt-hour was 3.882. The feed-water per engine horse power was 2.901. A comparison of the two results showed a saving in coal of 22.7 per cent. in favor of the tandem compound, and while this saving would have been less had there been one instead of two generators in the latter case, yet the results show unmistakably the economy of direct-connected units. Besides this, J. D. Rostron, civil engineer of the Chester Traction company, points out that the difference of the interest on the cost of installation would be comparatively small and would reduce the foregoing figure but about 7½ per cent.

Referring to the tests, Mr. Rostron writes as follows: "I have made other tests upon the same pair of engines, and the results show an economy of 20.6 and 21.3 per cent. I wish to note, however, from close observations, I find compounding or railroad work is productive of good results, providing the proper method of valve setting is adopted. I arrived at the present stage of economy after changing the relation of cut-off in the two cylinders three times on the present compound engine. One point to avoid is receiver expansion, which is a great loss."

CORRESPONDENCE.

New York Notes.

New York, November 23.—A conference was held last week between the Rapid Transit Commission and the Public Works Department, the engineers of both being present, in regard to the specifications to be put into the contract for building the rapid transit route in case the Supreme Court hands down a decision favorable to the building of the road. After the meeting, it was said that the conference had been entirely satisfactory. The Department of Public Works agreed generally with the plans of the Rapid Transit Commission as to the moving and replacing of sewers, etc., and in all cases an agreement satisfactory to all concerned was reached. The commission is making ready so that, if a decision is handed down by the Supreme Court favorable to the tunnel, it may make the formal advertisement for bids for building the road, the intention of the commission being to get the actual building of the road started at the earliest possible moment. John C. Sheehan, the Tammany leader, is reported as saying that it was true that he would try to secure a contract for some of the work of building the new rapid transit system in case a favorable decision is handed down by the courts. "Some time ago," said he, "a number of other contractors and myself made an examination of the plans for the proposed road, with a view to the organizing of a company to bid for the contract, but no definite arrangements have been made as yet to secure the work. From our investigation we consider the plans entirely feasible, but the work is one of great magnitude, and we could then make little progress in our plans. According to the contract that the Rapid Transit Commission will insist upon, the successful contractor must deposit $1,000,000 in cash in the city treasury, to remain there until the work is finished. Then he will have to give bonds for $5,000,000 more. Besides this, he must buy real estate along the route, to be used in building the road, and this would cost about $7,000,000 more. It is not easy to get all this money. I want to see the work carried out well, and I would like to get the contract. If bids are invited the firm I represent will try for the contract."

Some interesting figures are contained in the following statement issued on Thursday by Controller Fitch: "The Metropolitan Street Railway company paid to Controller Fitch yesterday $150,000 for their franchise percentage on the Broadway line for the year ending September 30, 1897, and the following sums of percentage on the other lines controlled by them. These moneys form a part of the income of the sinking fund, which has a number of sources of revenue not possessed by the other municipalities, towns and villages included in the Greater New York:

Second Avenue Railroad company:	
Main line	$ 1,747.48
Eighty-sixth street extension	1,470.33
First avenue extension	7,474.95
Columbus and Ninth Avenue Railroad	3,403.97
Metropolitan Crosstown Railroad	11,600 89
Metropolitan Crosstown Railroad extension	639.11
Lexington Avenue Railroad extension	275.38
Bleecker Street and Fulton Railway	2,234.53
Extension of Lexington avenue line	606.90
Houston, West and Pavonia Railroad:	
Extension of Chambers and Grand Street Railroad	610.95
Manhattan avenue extension of Columbus and Nioth Avenue Railroad	1,454.64
Fifty-third street extension of Columbus and Nioth Avenue Railroad	476.75
Twenty-eighth and Twenty-ninth Streets Railroad	2,509.47
Fulton Street Railroad	1,710.60
Thirty-fourth Street Crosstown Line	2,881.12
Chambers and Grand Street Railroad	5,839 56
Columbus and Ninth avenue extension of 109th street	261 10
Lexington Avenue main line	5,963.16
Harlem, Eighty-sixth street and Astoria extension of New York and Harlen Railroad	7,728.28
Total	$58,649.17

"Making together the sum of $208,649.17."

Col. John Jameson, general manager of the Union Subway Construction company, died at his home in Brooklyn on the 14th inst. Col. Jameson was born in Albany in 1841. His family removed to Wisconsin in 1847. At the outbreak of the Civil War he entered the volunteer service as a private in the Second Wisconsin Infantry, and in 1862 was transfered with his company to Battery B, First Wisconsin Artillery, in which he was advanced to senior first lieutenant. On September 5, 1865, he was mustered out of the service, after declining a commission in the regular army. Upon leaving the army he entered the service of the United States Postoffice Department as a route agent, and advanced through the different grades until in 1884 he was appointed general superintendent of the railway mail service by President Arthur. At the close of the Arthur administration he declined an appointment as major and paymaster in the regular army, and remained in the railway mail service until 1887, when he resigned to accept a position in the management of the company then engaged in the construction of the electrical subways in New York. Since that time he has been closely identified with the subway work in this city, and his careful study of the underground problem earned him a national reputation as an authority on the subject. He was frequently consulted by the officials of different cities on the question of the operation of electrical currents underground. Col. Jameson was a director of the Union Subway Construction company, the Consolidated Telegraph and Electrical Subway company, the New York Telephone company and the American Telephone and Telegraph company. M. S.

From Old Virginia.

Richmond, November 23.—The fact that Norfolk has recently become a subscriber to the American Telegraph and Telephone company, thereby securing speaking connections with other cities all over the country, has roused the residents of Wilmington, N. C., to what may turn out an effort to secure connections for that city. This company is rapidly running its lines southward, coming into Norfolk from Washington and Alexandria, and there would seem to be every reason to expect that Wilmington will be the next city to get the long-distance connection. Another line of the same company is in process of establishment through the central part of the country, and is completed as far south as Huntsville, Ala. It is claimed that its wires and poles are put up more securely than those of the telegraph companies, and this claim finds its proof in the statement that in the September storm of this year the wires of the telephone company stayed up five hours longer, and, after being finally blown down, were put up a good deal sooner, than those of the telegraph company.

An effort is being made to get the government to construct a telephone line from Hatteras to Ocracoke, N. C. A code of signals can then be used from the Portsmouth life-saving station. This will give connection with the telegraph line at Hatteras.

Last July Capt. Lewis F. Cooper, one of Winchester's City Council, sprung a surprise upon the council, and created a sensation in the town by making a proposition to furnish the electric lighting and the water for the town at half the cost now being paid for such services. The proposal was so much in contrast with the price they are now paying that the councillors have been holding aloof. At a late meeting of the council the proposition was renewed by the same gentleman, who requested early action upon the matter in order that he may have time to make the necessary changes in time to take up the work at the expiration of the present contract. If not accepted by December 1st the proposition will be withdrawn. Y. P.

PERSONAL.

Prof. Sidney H. Short and H. McL. Harding of the Walker company of Cleveland were in Chicago early in the week.

W. M. T. Weise, a member of the firm of Weise Bros., electrical contractors of Davenport, Iowa, was

in Chicago on Monday. Mr. Weise reports that the electrical business is slowly improving in Eastern Iowa.

John W. Sankey of the English manufacturing house of Joseph Sankey & Sons spent several days in Chicago recently. Mr. Sankey has visited many of the large electrical works of the country during his trip.

Mr. J. J. Philbrick, president of the Key West Gas and Electric Light company, Key West, Fla., died recently, aged 57. He was born in Keene, N. H., and went to Key West as paymaster at the United States naval station.

J. Appleton, the chief engineer of the Electric Storage Battery company, was in Chicago early in the week. Mr. Appleton was returning from a trip to San Francisco, where he installed a large battery plant in the Edison station.

Frank H. Clark, the recently appointed district manager for the Electric Storage Battery company in Chicago, is well known in eastern electrical circles. He came from Washington and has been connected with the storage battery business for some time, although formerly a central-station manager.

John M. Clark has been elected president of the Chicago Telephone company to succeed Robert T. Lincoln, who has resigned that position in order that he may devote his whole attention to the affairs of the Pullman company, of which he is acting president. Mr. Clark is a director and one of the largest stockholders in the Chicago Telephone company. He is also a well-known citizen of Chicago, has held the office of collector of the port, and until recently was chairman of the Civil Service Commission. Mr. Lincoln had served as president of the Chicago Telephone company since July 17th, when he was elected to succeed the late Henry B. Stone. Mr. Clark will now fill the remainder of the term until the annual meeting and election of the company during the latter part of January.

ELECTRIC LIGHTING.

H. G. Menmann has decided to erect a plant for electric lighting and has applied for a city franchise in Bessemer, Ala.

A Mr. Frank Whelan-Boyle, in an article in the Ludgate Magazine, denounces London as the worst lighted city in the world, with the exception of Pekin.

The installation of the People's Light and Power company of Newark, N. J., will shortly be increased by 18 125-light Brush arc dynamos, having a total capacity of 2,250 2,000-candle power arc lamps.

A notable change is about to be made at Omaha, Neb., where the new Omaha Thomson-Houston Electric Light company is undertaking the concentration of its system. It has recently placed an order with the General Electric company for three monocyclic alternators, each one to be directly connected to a compound condensing McIntosh & Seymour engine. These alternators will be revolving armature, 48 pole machines, each of 300 kilowatts at 150 revolutions, and will be separately excited. They will take the place of a considerable number of smaller machines and will be used to furnish current to an extensive system of three-wire secondary mains fed from large transformers.

ELECTRIC RAILWAYS.

All the street railroads in Munich are to use electricity as motive power within two years and charge a uniform fare of 2.4 cents.

The Engineer and Iron Trades Advertiser of Glasgow states that the offer of the Westinghouse Electric company to construct the electric plant for the new Springburn experimental route, at a cost of £19,657, has been accepted by the Glasgow tramway traction committee.

The street-car vestibule ordinance has been passed by the Chicago City Council. A neglect or refusal to comply with the provisions of the ordinance will subject the companies to a penalty of not more than $50 nor less than $10 for each day and each car used and operated in violation of the provisions of the ordinance.

J. T. Voss of Fort Worth, Tex., president of the Glenwood and Polytechnic Street Railway company, announces that the company is asking the City Council for a franchise over several streets on the South Side to extend this line, which in the future will be known as the Belt Line. The length of this connection will be 2¼ miles long, which will require about five more cars to be put in operation.

The canal commissioners met in Springfield on November 19th and considered two applications for a part of the right-of-way along the 90 foot towpath of the Illinois and Michigan canal from Joliet to La Salle. Both applications were rejected, and the commission decided not to act in the matter at present. The applicants desired the right-of-way for the purpose of constructing an electric railway. One of the applications was made by W. H. Holcomb of Chicago and H. B. Judson, also of Chicago, representing the Chicago, Burlington and Quincy road. The second application was made by U. J. Dunson and W. C. Rile of La Salle.

C. B. Storey of Hoosick Falls, N. Y., has the contract for building 11½ miles of single track of the Bennington and Hoosick Valley Railway company, which will connect with the Hoosick Railway company. The power will be obtained from the Hoosick Falls Water Power and Light company. Sixty-pound T-rails will be used throughout, and 14 cars will comprise the rolling stock. It is expected that the road will be in operation by December 15th.

The Delaware Terminal Railroad company of Sidney, N. Y., was incorporated with the secretary of state on November 9th, with a capital stock of $150,000, to build an electric road from the village of Sidney to the village of Franklin, in Delaware County, a distance of 14½ miles. The directors are Charles L. Burgess, Siegmund T. Meyer, David S. Meyer, John Nef and H. S. Meyer of New York city; Louis F. Raymond of Franklin and Edmund R. Halsey of Newark, N. J.

Lake Street Elevated express trains are soon to add to the loop complications and give rapid transit to Chicago's western suburbanites. This is vouched for by J. M. Roach, president of the Suburban Railroad company. He asserts that the elevated express trains will connect with the new Suburban electric line at the Fifty-second avenue terminus and deliver Oak Park and adjacent suburban residents to the heart of the city in less time than is required by any other method of transportation.

The St. Louis, Kansas City and Colorado Railroad company, which is preparing to make a practical test of the Seaton third-rail device, is 55¼ miles in length, extending from St. Louis to Union, Mo. The company was incorporated in 1884, and the earnings for the year ended June 30, 1896, amounted to $89,372, the operating expenses were $119,907, and the miscellaneous receipts of $815 brought the net deficit to $29,720 for that year. After taking into account the interest on the bonds there was a deficit of $115,380, bringing the total deficit up to June 30 last year to $1,741,092. The management hopes that with the introduction of electricity the expenses may be cut down so as to permit the continuance of the operation of the road.

The original ordinance granting a franchise to the Northwestern elevated road in Chicago provided that it should be finished by December 31, 1897, but an ordinance has been introduced in the City Council to extend the time to July 1, 1899. It is said that there has been much delay in building the road on account of legal proceedings and similar obstacles. The whole matter was referred to the committee on streets and alleys north. In connection with the application for more time on the part of Mr. Yerkes, a story was circulated around the City Hall to the effect that the railroad management had given out the information that were the extension refused it would be impossible to float the bonds needed for the completion of the road, but if it were granted $3,500,000 in ready cash would be forthcoming inside of 30 days. The general impression, accordingly, is that the extension will be promptly passed.

The Marietta and Parkersburg Traction company of Parkersburg, W. Va., which was granted a charter by the secretary of state of West Virginia week before last, to build an electric road from Marietta to Parkersburg, W. Va., has secured a part of the right-of-way between Parkersburg and Williamstown, W. Va., and it will be ready to begin work as soon as the bridge over the Ohio is ready. The incorporators are: A. McCash, Parkersburg, W. Va.; E. E. Wickson, Parkersburg; A. J. Yoke, Grafton, W. Va.; S. S. Stone, Vienna, W. Va., and W. W. Reynolds of Oil City, Pa. The City Council of Parkersburg granted a 50 year franchise to the Parkersburg Electric and Railway company over the streets of the city for an electric railroad. The franchise provides that the ordinance accompanying it must be accepted by the company within 10 days, construction work must begin within 30 days, and 10 miles of the road must be completed within 13 months. The company securing the franchise includes J. M. Jackson, Jr., C. H. Shattuck, John Busch, C. C. Martin, H. H. Moss, W. W. Van Winkle and others of Parkersburg. Negotiations are pending between the new company and the Park City Horse Car company for the absorption of the latter.

Electric cars are now running over the line of the Chicago, Harlem and Batavia railway, and as this line is part of the Suburban electric system, which now has connection with the Lake Street Elevated, it is expected that traffic on the latter road will receive material benefit. The Harlem and Batavia line has been operated by steam and its passengers have been carried into the city over the Chicago and Northern Pacific to the Grand Central depot. They will now be carried by electricity to Fifty-second street, where the Suburban connects with the Lake Street Elevated. It is thought probable that most of the former traffic of the Batavia and Harlem will be held for the new route and that it probably will be increased. It is intimated that the gain for Lake Street Elevated will be from 4,000 to 5,000 passengers per day. The electric equipment of the Harlem and Batavia was completed for the most part about four months ago, but an injunction against the crossing of the line through the town of Riverside and some trouble with the switching arrangements caused considerable delay.

Speaking of the heavy-traction electrical tests of the Pennsylvania Railroad company in conjunction with the Westinghouse company on the experimental tracks at East Pittsburg, the Philadelphia Press says: "It is what is known as the button system. The third-rail system is also to be tested in every detail. The tracks which the Pennsylvania company has established, and which the Westinghouse people are utilizing with an electric car, are supplemented by two interior rails. That is to say, it is not a single third-rail system, but is what may be called the double third-rail system. This system is now being tested upon these tracks, very largely for the purpose of determining whether the element of danger can be completely eliminated, and if this can be done, whether the system thus established can be operated as economically and as satisfactorily in other ways as the third-rail system with the live rail, such as President Clark is using upon the branch line near Hartford, Conn."

POWER TRANSMISSION.

The Salt Lake correspondent of the Engineering and Mining Journal says: "Probably up to the present the best paying electric power transmission plant hereabouts is the Utah, in Little Cottonwood Cañon. It furnishes power for the Salt Lake street-car service and is the only plant in this part of the state not embraced in the consolidation of the Union Light and Power company. Recently it is reaching out and is figuring to supply power to the mines of Bingham. It offers to furnish power at $80 per horse power per year, provided contracts can be made for 400 horse power. As most of the mines have to haul coal several miles uphill from the railroad, making the cost $6.25 to $7.50 per ton, a considerable saving can be made. Some eight or 10 mines are considering the proposition."

TELEGRAPH.

There is a project on foot for the connection of Victoria, B. C., with Anacortes by a telegraph line under the Western Union cable.

Vice-consul Jones, at Turk Island, W. I., has informed the State Department that a contract has been entered into between the Direct West India Cable company and the British government, to lay a cable from Bermuda to Turk Island and thence to Jamaica. The Telegraph Construction and Maintenance company of London has sent a steamer to the island to make the initial arrangements for the laying of the cable. It has been decided to land it at Riding Place, Grand Turk. It is anticipated that the cable will be in operation by the end of January, 1898.

ELECTRICAL SECURITIES.

The Consolidated Traction company of New Jersey reports for October gross earnings of $264.359; operating expenses, $130,159; net earnings, $134,199; fixed charges, interest and taxes, $113,972; surplus, $20,226. For the 10 months ended October 31st the surplus over all charges was $163,470, an increase of $97,279 over the corresponding period of 1896.

The Edison Electric Illuminating company of New York reports for the month of October gross earnings of $214,580.60, an increase over 1896 of $20,754.50. Net earnings were $91,398.65, an increase of $13,923.61. For 10 months the gross earnings show an increase of $182,702.47, and the net earnings an increase of $120,045.67. This is inclusive of high-tension systems.

The last 50 shares of the stock of the Columbus (O.) Electric Light and Power company have been deposited with the Capital City Bank and the property will be formally transferred to a New York syndicate. The franchise runs until 1920. A new company will be capitalized at $750,000, the plant largely extended and the cost of light and power reduced. The net earnings of the company last year were $42,000, it is said.

MISCELLANEOUS.

An ordinance licensing electrical engineers and contractors and defining their qualifications has been defeated in the Chicago City Council.

The sixteenth annual ball of the Chicago Association of Stationary Engineers was given on Thanksgiving Eve, and was a successful affair.

Charles D. Seeberger, secretary of the Chicago Club, has devised a new form of moving stairway for "L" road stations. Stairsteps are fastened to endless belts, which are electrically operated.

At the meeting of the Engineers' Society of Western New York, on November 9th, Newcomb Carlton read a paper on "The Northern Elevator and the Application of Electricity to its Operation, as Well as to Other Mechanical Appliances."

At the annual meeting of the American Society of Mechanical Engineers at New York, on November 30th, two papers will be presented upon electrical subjects. W. S. Aldrich will read one on "Rating Electric Power Plants on the Heat-unit Standard."

The other will be entitled "Electricity in Cotton Mills," and will be prepared by W. B. Smith-Whaley.

It is said that tandem bicycles equipped with storage batteries and motors are used in Paris as pacing machines. These bicycles must be much heavier than ordinary tandems, but it is said that they can be operated at a speed as high as 50 miles an hour.

The foundation for the power house located on the Yadkin River, near Winston, N. C., has been laid, and it is expected that the plant will be in operation by February 1st. The company, which has $150,000 capital, expects to develop 5,000 horse power in all. At present the power will be obtained from a plant representing 2,500 horse power, which will be obtained from eight turbine wheels. The location, it is stated, is one of the most desirable in the South for a power house, and the company calculates to furnish both power and light to Winston and Salem. The building is to be three stories in height, to be constructed of brick and granite. Among those interested are H. E. Fries of Winston and S. Morgan Smith of York, Pa.

Copper production in the United States in October reached a total of 17,541 tons and was closely up to the average of the 10 months of the present year. It shows, however, a decrease of 3½ per cent. from October of last year, and is considerably below that of the earlier months of the present year. The total United States production for the 10 months ended with October was 176,388 tons, which was greater by four per cent. than in the corresponding period last year. Exports of copper from the United States showed a considerable decline as compared with previous months, and were 2,586 tons less than in October, 1896. The total this year has been 108,975 tons, which is 8,384 tons more than last year. The export this year has been 62 per cent. of the production. The foreign production shows little change this year; but the consumption abroad seems to keep up very well.

An electric car for fire engines has been introduced by an eastern firm. The car consists of two motor trucks supporting between them a platform large enough to hold a regulation fire engine. The extreme length is 30 feet 10½ inches; greatest width, eight feet 6½ inches, and height of car floor above the track, 9½ inches. The total weight, including trucks and suspended floor, is 14,000 pounds. The car can be propelled by motors mounted upon the axles, as is customary at present, or it may be drawn by an electric locomotive, or an electric car can be impressed in an emergency. To load on a fire engine the side channel beams are released from the front truck and lowered until the front end of the floor rests upon the ground. The forward truck is then run ahead out of the way, the engine backed into place and drawn on the platform by a winch on the rear truck. The front truck is then run back to its former position and the channels raised to place by a windlass. In the course of a recent test it was demonstrated that the car could be run into position, uncoupled, the engine loaded on and all made ready for a trip in 2¼ minutes. Better time was made in unloading, only 1¼ minutes being required to detach the forward truck and hitch the horses ready for a run.

TRADE NEWS.

The General Electric company states that during the months of June, July and August it received orders for 278 generators, aggregating nearly 14,000 kilowatts, for lighting purposes alone.

The Electric Third Rail and Signal company of St. Louis has been incorporated to introduce and manufacture apparatus for the operation of the Seaton third-rail electric system for street cars. The capital stock is $250,000.

The popular representative of the Electric Railway Equipment company dropped into Chicago from Cincinnati last week. Mr. Wick was looking after the Railway Equipment company's Chicago trade, but he only spent a few days in the city.

The Norwegian Mica company has been organized in Christiania. The company is working mines of mica in Norway. The professor of mineralogy at the University of Christiania, Yohan H. L. Vogt, is a director, and Henry E. Mohn is president.

A. N. Loper, representing the New Haven Car Register company of New Haven, Conn., was in Chicago last week, looking after the interests of his company. Mr. Loper seems to be ubiquitous. He is here to-day, there to-morrow, and always on the go.

Since the advance agent of prosperity has swept the country and renewed activity is noticeable in all branches of industry, especially in the electrical business, rumors of all kinds are constantly finding their way into the columns of the daily papers. One of the latest is that the Westinghouse Electric and Manufacturing company will build a branch factory at Buffalo, N. Y. Color was given to this story, no doubt, by the fact that the Westinghouse Electric and Manufacturing company is doing such an amount of business at Buffalo and Niagara Falls that people think that the entire factory is moved up there. However, this is not the case. The existing factory of the Westinghouse company at East Pittsburg, Pa., is said to be the most complete establishment for the manufacture of electrical machinery in the world.

The Automatic Circuit Breaker company's plant at Newaygo, Mich., formerly belonging to the Sweet Automatic Circuit Breaker company of Grand Rapids, has been sold under first mortgage and was purchased by the Furniture City Electric company of Grand Rapids. The plant employed about 20 hands. The machinery alone was valued at $4,500, and the stock on hand at $2,000. A representative of the purchaser states that it will at once be returned to Grand Rapids, and that the manufacture of circuit breakers will be continued as a part of the present business of manufacturing, repairing and contracting.

Some managers of electric light plants do not realize the economy resulting from the use of a good steam engine indicator. With one of these instruments it is said that a saving of from 10 to 40 per cent of fuel may be made. A fallacious idea is that the services of an expert are required to operate one of these instruments. James L. Robertson & Sons, 204 Fulton street, New York, claim that all of the complication has been dispensed and that any ordinary engineer may secure the best results from the improved Robertson-Thompson indicator, Victor reducing wheel, and Lippincott planimeter, the last-named instrument giving the mean effective pressure direct for any spring without computation of any kind. An instructive catalogue of these instruments may be had by addressing the manufacturers.

The many friends of Secretary Paul W. Bossert of the American Telephone company, Chicago, will doubtless be surprised to know that he has resigned his position with the American Telephone company to assume the duties of general manager of a new company to be known as the "Pennsylvania Electric company of Philadelphia, Pa." This new concern will make a specialty of manufacturing magneto bells and telephone receivers. The factory of the Pennsylvania Electric company will be at Marietta, Pa. The building is already erected and the work of manufacturing is expected to commence soon. It is Mr. Bossert's purpose to locate his Philadelphia office, if possible, in the Bourse building, although this has not yet been decided upon. The Pennsylvania Electric company realizes the great future and the possibilities in catering to the vast and rapidly growing telephone interests in the United States and other countries, and friends of Mr. Bossert who best know the telephone situation feel that his move is a wise one. Mr. Bossert has had a valuable experience in the telephone business, one that should be of great value to the new organization. While he has not as yet left his desk at the American company's office, he nevertheless expects shortly to go to Philadelphia.

It is said that, with an output of over 6,500,000 lamps yearly, the General Electric company is manufacturing a better and more uniform lamp than formerly could have been procured for double the price. So large a production and sale naturally allows of the adoption of improvements. The lamp works are provided with a very complete laboratory, with a staff of competent chemists and electricians constantly occupied in carrying on experiments and tests, all tending to the betterment of the product. Perhaps the most noteworthy improvement introduced during the last two years is the new exhaustion process. By the adoption of this process the quality of the Edison lamp is distinctly advanced beyond lamps exhausted by other methods. During recent years mechanical exhaust pumps, that is, pumps operated without mercury, have from time to time been presented, but in each case the size of the pump has been too great, the object having been to exhaust a large number of lamps at one time. This practice being considered injudicious, such pumps have not been adopted, but the lamp works have succeeded in obtaining a small mechanical pump, with a rate of exhaustion such that it can practically be employed to exhaust one lamp at a time. Experiments with this pump lasted nearly two years, and showed that the lamps could be exhausted more nearly the ideal lamp vacuum by this pump than by any other. It is now used to exhaust the Edison lamp, and the mercury pumps have been discarded. The final perfection of the vacuum, however, is not obtained by the pumps unaided. In combination with these pumps a chemical process is introduced, exclusively used in this country by the lamp works, and as the various phenomena of exhaustion are clearly marked, a very definite rule of operation has been formulated. The natural residual gases of an incandescent lamp may be considered conducting gases, since they allow current to pass from one leg of the filament to the other. The residual gases are, therefore, not only injurious to the filament, but their necessary removal has previously involved long and tedious processes. By the new method of chemical exhaustion, all the residual gases are thoroughly removed from the lamp by the introduction of a gas capable of combining with them. Previous to this introduction a blue glow fills the bulb when the filament is brought up to bright incandescence, but when the combination takes place between the residual gases and the new gas the blue glow suddenly disappears, and a lamp "sealed off" at this moment has a vacuum of perfect insulating properties. The advantages of the chemical process of exhaustion are several. The combination of the gases in the bulb is a phenomenon so marked as to furnish an absolute proof that the proper vacuum has been obtained. The lamps are exhausted one at a time, and the whole attention of the operator is concentrated on a single lamp. This insures a perfection of vacuum difficult to obtain in lamps exhausted in groups. The operator sits in a comfortable position and, not unduly wearied, can do as accurate work late in the day as in the morning. The injurious effects of mercury upon the health of the operator being avoided, his uninterrupted service is secured and the very highest skill dependent upon continued practice is retained.

BUSINESS.

The new governor for the steam engines made by the Ball Engine company of Erie, Pa., is illustrated and concisely described in a recently issued circular, which is sent on application.

Blotters can be had from the Diamond Electric company, 1202 Fisher building, Chicago, showing pictures of the Scheeffer wattmeters and transformers and the Cardew earthing device, and setting forth the merits of these appliances.

The first of the '98 calendars to reach the office of the Western Electrician is from the Missouri Telephone Manufacturing company of St. Louis. This enterprising concern sends it out, a little in advance, with the "compliments of the season."

The D. A. Kusel Telephone and Electric Manufacturing company, 1110 Pine street, St. Louis, has just finished the contract to furnish line material and 35 long-distance telephones for the lines running into Fulton, Mo. It has also furnished an exchange for Arkansas and has several other contracts on hand from Missouri, Illinois and Texas. Business prospects are bright.

The Monon Route's new through sleeping-car line between Chicago and Washington and Baltimore, via Cincinnati, the C., H. and D., B. and O. S. W. and B. and O. railways has proven a great success. The sleeper is ready for occupancy in the Dearborn station at 9:30 p. m., and leaves at 2:45 a. m. daily, arriving at Washington at 6:47 and Baltimore 7:55 the following morning. As the sleeper goes through without change, and as the hours of leaving and arriving are so convenient, this is a very comfortable as well as the most picturesque route to the national capital. The city ticket office is at 232 Clark street.

Treasurer Charles Landis of the American Reflector and Lighting company of 271-273 Franklin street, Chicago, reports a factory full of orders. The American Reflector company manufactures over 150 styles of reflectors for electricity, gas and oil. It is impossible to realize the full extent of the line of reflector goods carried by this institution without the aid of one of its complete catalogues, which will be sent on request. The American Reflector company is making a specialty of all styles of reflectors for users of electric light under almost every condition. It makes reflectors for lighting art galleries, window reflectors, orchestra shades, incandescent street electric light hoods, stage dimmers, incandescent calcium light theatrical lamps with hand feed, also reflector chandeliers, hall and vestibule lamps, silver-plated mirror reflectors for incandescent clusters with prisms—in fact, it is safe to say anyone desirous of purchasing anything in the line of reflectors can find goods to suit him in the Chicago salesroom of the American company.

The K. & W. company of Pittsfield, Mass., has been manufacturing a line of specialties which is prominently known among the central stations and isolated plants. Appreciating that there was a demand for an incandescent lamp which possessed some features not embodied in those now offered for sale, the company decided to add this branch of business to its concern, and it was decided to take larger quarters in the new manufacturing building recently erected by W. A. Whittlesey, securing a portion of the first floor for the offices. The lamp department will be under the management of S. M. Hardy, who has been prominently identified in the manufacture of incandescent lamps for several years. Until recently Mr. Hardy was superintendent of the Imperial lamp factory at Marlboro, Mass. The most improved apparatus for the manufacture of incandescent lamps is now being installed, and it is the intention to make this the most complete factory in the country in this line. For candle power and mechanical finish the lamps will demand the attention of those who ask for the highest grade lamp, and are willing to pay a slight advance over the price of cheap lamps and thereby save money. The company states that nothing but the best skilled labor will be employed in its factory, placing no reliance upon cheap help and child labor, and with this end in view Mr. Hardy has brought with him from Marlboro a force of workmen who have grown up in the lamp business. The new lamp will be known as the Hardy incandescent lamp, and it bids fair to achieve a strong position in the electrical trade. The K. & W. dynamo brushes, hanger-boards, spark arresters, etc., will be manufactured as usual, and arrangements made to meet the increased demand for these products. The officers of the K. & W. company are W. A. Whittlesey, president; J. H. Kelman, secretary; F. R. Whittlesey, treasurer, and S. M. Hardy, manager of lamp department.

ILLUSTRATED ELECTRICAL PATENT RECORD.

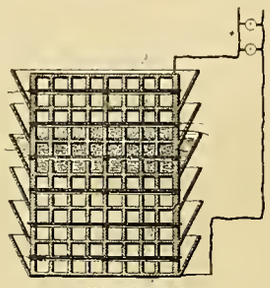
Issued November 16, 1897.

593,559. Storage Battery. Edward A. Barber, Watertown, N. Y. Application filed May 14, 1897.

This battery comprises a stack of trays, each of which has on opposite sides of its bottom portion an integral compartment plate, the compartments in which contain the active material, insulating strips on the upper edges of the outer and central dividing walls of the compartment plates, the asbestos sheets resting on the strips, the lower surface of each plate resting on an asbestos sheet, the positive and negative plates at the top and bottom of the trays respectively, and electrical connections therewith.

593,571. Magnetic Clutch. Thomas J. Fay, Brooklyn, N. Y. Application filed February 5, 1897.

The hermetically sealed case contains a machine having a main rotating shaft, a driving motor and its rotating shaft located outside of the casing, an electro-magnetic clutch having its two members mounted respectively on the two rotating shafts, one member being inside the casing and the other outside thereof, an unperforated wall of the casing composed of dielectric material being interposed between the two members of the clutch, and through which the clutching and unclutching of the two rotating shafts is effected.



NO. 593,559.

593,611. Multiple Switchboard System for Telephone Exchanges. Charles E. Scribner, Chicago, Ill. Application filed May 13, 1892.

The combination is described with a telephone line circuit of a repeating coil, one of whose coils is included permanently in the line circuit, and the other of whose coils is included in a local circuit with an individual annunciator, and means for shunting the first-mentioned coil of the repeating coil when connection is established with the line.

593,612. Toll Counter for Telephone Lines. Charles E. Scribner, Chicago, Ill. Application filed September 10, 1894.

One claim is for a magnet having a permanent field, two electro-magnets and means for intermittently exciting them independently of each other, an armature having projections adapted to come successively into the permanent field, the electro-magnets being adapted when successively excited to bring a new projection into the permanent field.

593,613. Polarized Signal Bell. Charles E. Scribner, Chicago, Ill. Application filed November 25, 1895.

A local storage battery is placed in the line at a sub-station, and provided with means for producing alternating currents in the line, an electric bell whose electro-magnet is provided with two differential windings in different parallel branches of the line circuit, one of which branches is constructed to have high impedance, whereby the bell remains neutral to the charging current, but may be operated by alternating current.

593,614. Telephone System. Charles E. Scribner, Chicago, Ill. Application filed September 25, 1896.

The telephone line has a transmitting telephone and an induction coil at its sub-station and terminates in an appliance for establishing connection with another telephone at a central station; a supply circuit distinct from the line permanently includes the transmitting telephone and the primary winding of the induction coil at the sub-station and terminates in a separate contact piece of the appliance; a source of current at the central station, a switch contact forming the terminal thereof, and means for applying the switch contact to the contact terminal of the supply circuit in the act of making connection with the line.

593,625. Insulated Hanger. Ernest P. Warner, Chicago, Ill. Application filed March 8, 1897.

Lugs are formed upon the interior of a metallic hood; a metallic ring is supported by the lugs; a glass insulator retained in position within the hood by the ring, a hook, the shank whereof passes through the insulator, and a disk secured to the end of the shank and supported by the insulator, the disk being of such diameter that it cannot pass through the ring.

593,626. Electric Arc Lamp. Ernest P. Warner, Chicago, Ill. Application filed March 16, 1897.

There is the combination with a chain or ribbon supporting the carbon, of a controlling wheel over which the chain or ribbon is passed, two rotatable clutching members, mounted one at either side of the controlling wheel, link connections between the clutching members, whereby independent rotation of one of the members with relation to the other varies the distance between them, causing engagement or release of the controlling wheel, and electro-magnetic means for causing such independent rotation, thereby to effect the regulation of the lamp.

593,627. Telephone. John Weil, Mansfield O. Application filed February 25, 1897.

The shaft is mounted in a generator box, a lever being pivotally mounted on the shaft and formed at its free end with a receiver hook, a crank mounted on the shaft, a rod pivotally connected to the end of the crank, a bow-spring having one end secured to the casing of the box and the other pivotally mounted upon the lower end of the rod, so as to normally force the same upward, a pivoted switch-lever connected to the rod, and contacting points connected with the bell and main-line circuits, and adapted to be engaged by the switch lever.

593,692. Electric Signaling Mechanism. Lewis G. Rowand, Camden, N. J. Application filed December 22, 1896.

Included in this device are a normally closed circuit, a magnet upon the circuit, a second circuit having a signal or signals thereon, a switch comprising two members, one of which is moved by the magnet in one direction, and means independent of the magnet to move it in the other direction, and means to hold the second member of the switch out of alignment with the first-mentioned switch member when moving under the action of the magnet.

593,697. Electric Arc Lamp. Clarence C. Stirling, Hartford, Conn. Application filed February 6, 1897.

Feeding mechanism is provided for the carbons, comprising a feeding-screw for each carbon, one of which is made hollow and internally screw-threaded to receive the other, means for turning the hollow screw-shaft by hand, and an actuator consisting of a motor comprising a field magnet and a rotary armature, the latter being operatively connected with the hollow screw-shaft.

593,716. Alternating Current Motor. Alexander J. Churchward, Brooklyn, N. Y. Application filed July 1, 1896.

A single-phase self-starting alternating current motor has its field excited when running as a synchronous motor by two coils, one of which provides a contact field excitation, while the other carries current increasing with the load and obtained from a commutator located, as described, between armature and field, so as to cause the alternating current supplied to the motor and flowing in coils of the armature as an alternating current to flow through the field as a continuous current.

593,718. Electrically Driven Gas Machine. Thomas J. Fay, Brooklyn, N. Y. Application filed February 25, 1897.

Claim one is given: The combination of a sealed gas casing, an electric motor located outside thereof, and whose field magnet system itself forms a sealed casing, and a sealed gas passage connecting the motor and casing together and through which the armature shaft leads.

593,720. Telephone Toll Station. William Gray, Hartford, Conn. Application filed November 17, 1893.

In combination with a set of telephone instruments there are a signal-box containing a channel board, a signal device located in the path of the falling coin, openings through the wall of the box for the reception of a coin, the channel board secured in firm contact with a wall of the signal-box, the transmitter and the transmitter support secured in firm contact with that part of the signal box to which the channel board is secured.

593,738. Electric Arc Lamp. William H. Coughlin, Worcester, Mass. Application filed April 9, 1897.

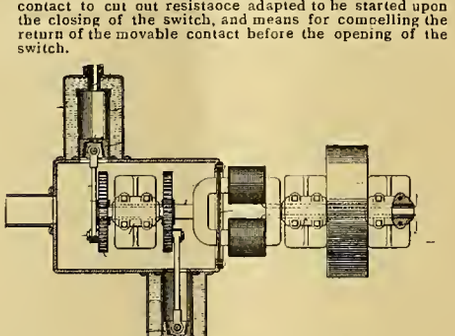
The special features of construction in the globe holder include the spindle, having an opening therethrough, with a solid metal bearing seat at the bottom of the opening, in combination with the swinging dog arranged in the opening, and having one end horizontally pivoted near the lower part thereof, its head or free end adapted to normally fall outward and project laterally from one side of the spindle, with the side of the dog supported upon the solid bearing seat, the dog adapted to be turned upward within the opening to permit the globe-supporting collar to pass onto or from the spindle.

593,803. Electric Battery. William W. Hanscom and Arthur Hough, San Francisco, Cal. Application filed April 21, 1897.

The method of constructing elements for storage batteries consists in electrolytically producing slabs of spongy lead, then compressing the same about the edge to a dense mass, and welding metallic lead upon the compressed edge to form a frame.

593,817. Rheostat. George J. Schneider, Detroit, Mich. Application filed March 5, 1897.

With a circuit-closing switch and the movable contact of a rheostat there is a time motor for actuating the movable contact to cut out resistance adapted to be started upon the closing of the switch, and means for compelling the return of the movable contact before the opening of the switch.



NO. 593,571.

593,819. Telephone and Signaling or Calling System. James G. Smith, New York, N. Y. Application filed April 4, 1895.

The signaling system comprises a plurality of stations, a circuit for the stations divided into sections in each station, and electrically operating devices in each station arranged to be operated directly from any of the stations for connecting two sections of the circuit together to establish a through line between any two of the stations.

593,820. Electric Signaling or Calling System. James G. Smith, New York, N. Y. Original application filed April 4, 1895. Divided and this application filed July 14, 1897.

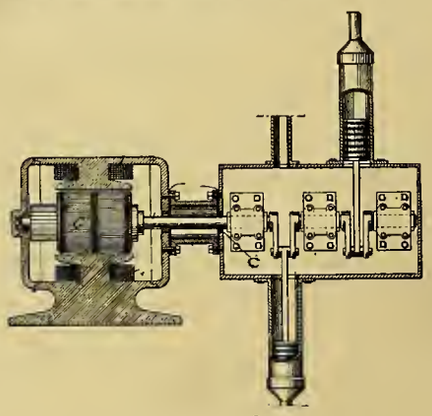
A circuit for the stations is divided into sections in the stations, two magnets on the circuit in the stations, an armature for each of the magnets, one of the armatures being arranged to break the circuit of the signaling instrument in its station and to connect two sections of the circuit to partially establish a complete circuit through the station, the other of the armatures being arranged to temporarily break the circuit and then complete the circuit.

593,832. Electric Brake for Elevators. John P. Casey, Bloomsburg, Pa. Application filed August 23, 1894.

The electric motor rotates the shaft; a friction gravity brake is adapted to arrest the rotation of the shaft; an electro-magnetic device for removing the brake is provided with high and low resistance coils for producing the same polarities in the electro-magnetic devices; an electric circuit including the low resistance coil in series with the armature, a shunt circuit including the high resistance coil in shunt relation with the armature of the motor, and a switch device for controlling the flow of current through the circuits for always maintaining the current flowing in both coils of the brake magnet in the same direction at any moment of time.

593,852. Multiple Metering of Electric Currents. Eustace Oxley, Washington, D. C. Application filed October 2, 1897.

In a process of multiple-rate metering of electricity there is the combination with suitable metering or registering apparatus of an electro-magnetic device suitably located and arranged with relation to each point where a multiple rate is given, a normally open circuit for the electro magnetic device, and means located at a single point for establishing the circuit at suitable intervals to control the metering or registering apparatus in showing the consumption of current at different rates.



NO. 593,718.

593,853. Electric Cut-out. Harry T. Paiste, Philadelphia, Pa. Application filed July 8, 1897.

The base has contact plates and line-wire connections, the cap having plates forming electrical connections with the contact plates of the base, and other plates providing for mechanical connection therewith, and set-screws for effecting this mechanical connection, the latter and the line-wire connections being wholly outside of the limits of the cap, and the electrical connections being wholly inside of the same.

593,858. Indicator for Electrical Measurements. Edward B. Rosa, Middletown, Conn. Application filed July 13, 1897.

In apparatus for recording instantaneous values of electrical quantities, the combination with an instantaneous contact maker having a brush adapted to move periodically, of a recording surface adapted to move in synchronism with the brush, and means for recording the electrical values on the surface.

593,877. Igniting Device for Gas or like Motors. Albert de Dion and Georges Bouton, Puteaux, France. Application filed September 5, 1896. Patented in France September 13, 1895; in Switzerland October 17, 1895; in England October 21, 1895, and in Germany October 23, 1895.

The apparatus consists of a vibratory conducting strip or circuit-closer, having a shoe, a conducting contact point, wires connected to both and to the terminals of the primary of an induction coil, and a notched disk upon the periphery of which the shoe of the circuit-closer rests out of contact with the point, and at each revolution falls into the notch and closes the circuit of the primary of the induction coil.

593,884. Electric Annunciator. James A. Gowans, Stratford, Canada. Application filed April 3, 1897.

A suitably carried motor consisting of field magnets and a suitably supported rotatable armature and a stop-arm connected to the shaft of the armature of the motor are in combination with one or more electrically actuated stop mechanisms, and means for causing a current to pass through the motor and to any one of the stop mechanisms, so as to draw the stop-arm round to and arrest it at the stop mechanism.

593,899. Electric Arc Lamp. George R. Lean, Cleveland, O. Application filed January 23, 1897.

The claim: The combination with an arc-inclosed alternating current arc lamp, of cored carbons, the cores of which are one-sixteenth of an inch in diameter or less.

593,914. Electric Switch. Will M. T. Weise, Davenport, Ia. Application filed February 24, 1897.

One claim is for a telephone line having a main and a ring circuit, a plurality of phones and switches therefor in the line, actuating members for said switches, a central switch controlling the phone switches, a contact controlling the main and ring circuits, the circuit contact having frictional connection with the central switch.

593,919. Electrical Switchboard for Coin-operated Machines. Jerry L. Blodgett, Los Angeles, Cal. Application filed July 20, 1897.

Electrical contacts are beneath the receptacle to support a coin in the receptacle, and be thereby electrically connected to make a circuit; a lever for moving the slide and a lock for locking such lever and arranged to be released by the magnet are also provided.

593,965. Coupling for Electric Circuits in Railway Trains. James Merryweather, Greencastle, Ind. Application filed October 7, 1897.

A coupling device for electric signaling circuits on railway trains is composed of two halves, one coupling half being box-like in general form with swinging doors for the contact surfaces, and the other consisting of a plunger or arm adapted to pass into the box-like coupling half and in contact with the doors thereof.

Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, DECEMBER 4, 1897. No. 23

Compact Central Station.

An example of excellent design and construction is presented in the central station at Flushing, L. I., where particular attention was given details that would insure economical operation. Small electric stations as well as the larger ones possess interest for the engineer, and present problems that are often more difficult of solution and are of a peculiar kind, demanding engineering ability of a high order, as it becomes a question not of warranting the employment of all the little and big economies devised, but of handling a more variable quantity at retail, on a scale which would render the economies referred to extravagances, and yet produce a fairly economical mechanism. This latter problem is the one that was presented in the city of Flushing, L. I.—a small but thrifty and growing community which had already outgrown one plant, but which, with the metropolitan bee buzzing in its ears, demanded something more modern than had done service in its village days.

The situation was not far different from that which is found in many other small communities consisting largely of residences somewhat widely scattered and small retail stores, the characteristic of the service being an extremely low-load factor. To meet this service economically, to provide for a small power demand already existing which it was desired to cultivate and increase, and to furnish direct current arc lighting for the streets and stores, were the particular conditions which confronted the mechanical engineer of the company, F. H. Thompson, and the contracting engineers, Westinghouse, Church, Kerr & Co.

The buildings are located on a narrow strip of land lying between the water and Lawrence street, near Bridge street, and consist of two communicating structures, in one of which is located the steam generating apparatus, and in the other the engines, dynamos and offices. They were both built by the Berlin Iron Bridge company, and consist of skeleton steel construction filled in with brick. The roofs are of corrugated iron, with monitors on each, providing ample ventilation and light, carried on steel trusses. The engine room is provided with the Berlin Iron Bridge company's non-conducting, fireproof, non-condensing lining. In both the boiler and engine room the floor is one solid body of concrete, and the whole is absolutely fireproof.

The boiler house, which faces on the water, occupies a ground area of 40 feet six inches by 40 feet, and is equipped with four 61-inch Manning high-pressure boilers, each of 130 horse power, Centennial rating. These are arranged along one side of the room, as shown in Fig. 2, and adjoining them, next to the dynamo room are located the boiler-feed pumps, which are of the Dean duplex type, six inches by four inches by six inches.

Beneath the building the company has sunk an artesian well, from which the water supply for the boilers is taken by a low-service steam pump, and discharged either into a large tank just outside or directly into the exhaust steam heater. Arrangements are made, however, so that the pumps can draw either from the exhaust heater, the tank, the well or the city water mains.

Directly over the condensers, and therefore occupying no otherwise useful space, are located the live steam purifier and exhaust steam heater. The Hoppes system of feed-water purifying is used, as the quality of the water is not the best. The water is usually pumped from the well by the low-service system into the exhaust heater, and thence by the boiler-feed pumps into the live steam purifier, whence it descends by gravity into the boilers, the elevation of the purifier being sufficient for this purpose.

The steam for operating all of the auxiliaries is ordinarily taken from the live steam purifier instead of from the boilers direct, so as to provide circulation in the purifier, but provision is made, by means of a supplementary header connected with each boiler, to permit direct connection in case the purifier is for any reason out of service. The exhaust from all the auxiliaries is discharged into the heater.

The condensers, which are also located in this corner of the building, are of the Dean independent type in pairs, and are arranged with by-passes so that either condenser can be run with any combination of engines. The exhaust pipes are provided with automatic relief valves, and the condensers are supplied with salt water throught cast-iron suction pipes.

The equipment (Fig. 3) occupies one side of the boiler house, the foundations for an exact duplicate being provided on the other side. Thus it will be seen that within an area of 1,620 square feet of floor space there is provided generating capacity for 1,040 horse power, Centennial rating, or about one horse power to each 1.5 square feet, including all auxiliaries, pumps, condensers, steam heaters, purifiers and coal room.

Just without the boiler room is located the stack, which is worthy of notice. This is a steel cylinder

FIG. 1. COMPACT CENTRAL STATION.—ENGINE AND DYNAMO ROOM.

54 inches in diameter and 125 feet high, weighing 24,000 pounds, and was erected in one piece. Its foundation consists of a solid block of concrete, 15 feet square and 10 feet deep, laid on piles. On account of the narrowness of the property, which is bounded on the one side by the street and on the other by the water, it was impossible to support this tall shaft by guy wires, so it was necessary to design it to be self-supporting. The stack is shown prominently in the exterior view, Fig. 4.

The building having the engine and dynamo room also contains the offices, but these are partitioned off at one end. The structure is connected with the boiler house by a single door, measuring 41 by 48 feet inside, and contains, besides overhead cranes running the entire length of the room, four Westinghouse compound automatic engines, with cylinders measuring 12 inches and 20 inches by 12 inches and indicating 150 horse power when operating condensing at 125 pounds of steam.

Two of these are located on the east side of the room, each driving a 75 kilowatt two-phase Westinghouse alternator and a small direct current exciter, and there is a foundation for another unit of the same size. These are for the incandescent lighting and power service, and on the other side of the room are located the other two engines of the same size, devoted to direct current arc lighting service. This is supplied by three Westinghouse 75 light and one 100 light direct current open coil arc machines. There is also a reserve incandescent dynamo of 75 kilowatts capacity on this side.

The method of driving these machines is one which, while not entirely new, is not yet very common; namely, the L. P. and D. transmitter, manufactured by the L. P. and D. Transmitter company of Montpelier, Vt. This feature is well illustrated in Fig. 1. One of the advantages which commended this device to the engineers was that it permitted of very close belt centers—two of the arc machines

FIG. 4. COMPACT CENTRAL STATION.—EXTERIOR VIEW OF STATION SHOWING STACK.

being belted on four feet three inch centers, and both of the incandescent machines on eight feet six inch centers, which is certainly about as compact an arrangement as is possible where, on account of the smallness of the units, it is advisable to use belt transmission. Another illustration of its utility is shown in this station on the arc light side of the building. As already mentioned, this side of the room contains two 150 horse power engines from which are driven four arc light machines, but it was the design to hold one of these machines and one of these engines as a reserve. To accomplish this and to add flexibility to the system, these engines were connected with a jack-shaft by means of jaw clutches, and the arc machines were driven from separate pulleys on this jack-shaft by the L. P. and D. transmitters. The incandescent reserve unit is driven from the spare arc engine unit. With this arrangement, either engine may be thrown into connection with the shaft, and any or all of the arc machines or the reserve incandescent machine may be thrown either in or out of service, without the aid of clutches, by simply changing the adjustment of the transmitter belt.

All of the engines are operated condensing, a single valve and a single eccentric controlling the steam of both cylinders. This is a great simplification over the usual valve gear of compound engines, and permits of their being operated non-condensing or condensing without any changes in the valves or their setting.

Lubrication is both copious and economical, and is effected in the manner peculiar to this make of engine, by the churning action of the crank-shaft and connecting rods running at high speed in a closed reservoir of oil and water, the splash deluging every friction surface. The governor is also enclosed in a case which is filled with oil, so that the lubrication is both generous and automatic and all wastes are prevented.

The incandescent lighting machines are of the Westinghouse two-phase type, the armature being drum-wound with connections taken out at four points 90° apart. The current is distributed at 2,000 volts with 7,200 alterations, supplying lights on the single alternating system and power on the two-phase system.

Returning now to the arc light machines, it is worthy of mention that they are of the constant-current open-coil type, but, while really wound as two-phase machines, they are commutated so as to give a unidirectional current. Instead of being self-excited, as is usual, with direct-current arc machines, these are separately excited from a small exciter, which also does service when necessary in supplying the station lighting. This commutated two-phase current is slightly pulsating, but this is claimed as an advantage, as it causes a very slight but constant vibration in the moving mechanism of the arc lamps which materially reduces the chances of sticking or failure to feed without perceptibly affecting the steadiness of the light. As shown in Fig. 5, the armature coils are entirely enclosed in the metal of the armature, so that it is effectually protected from possible mechanical injury. The stampings of which the core is built up have eight T-shaped teeth upon which the armature coils previously wound on forms are mounted and held in place by wooden wedges dovetailed in. By the arrangement employed, the replacing of a damaged coil is an exceedingly simple matter and can be performed by an ordinary mechanic in a very short time.

A word also about the commutator (Fig. 6) and

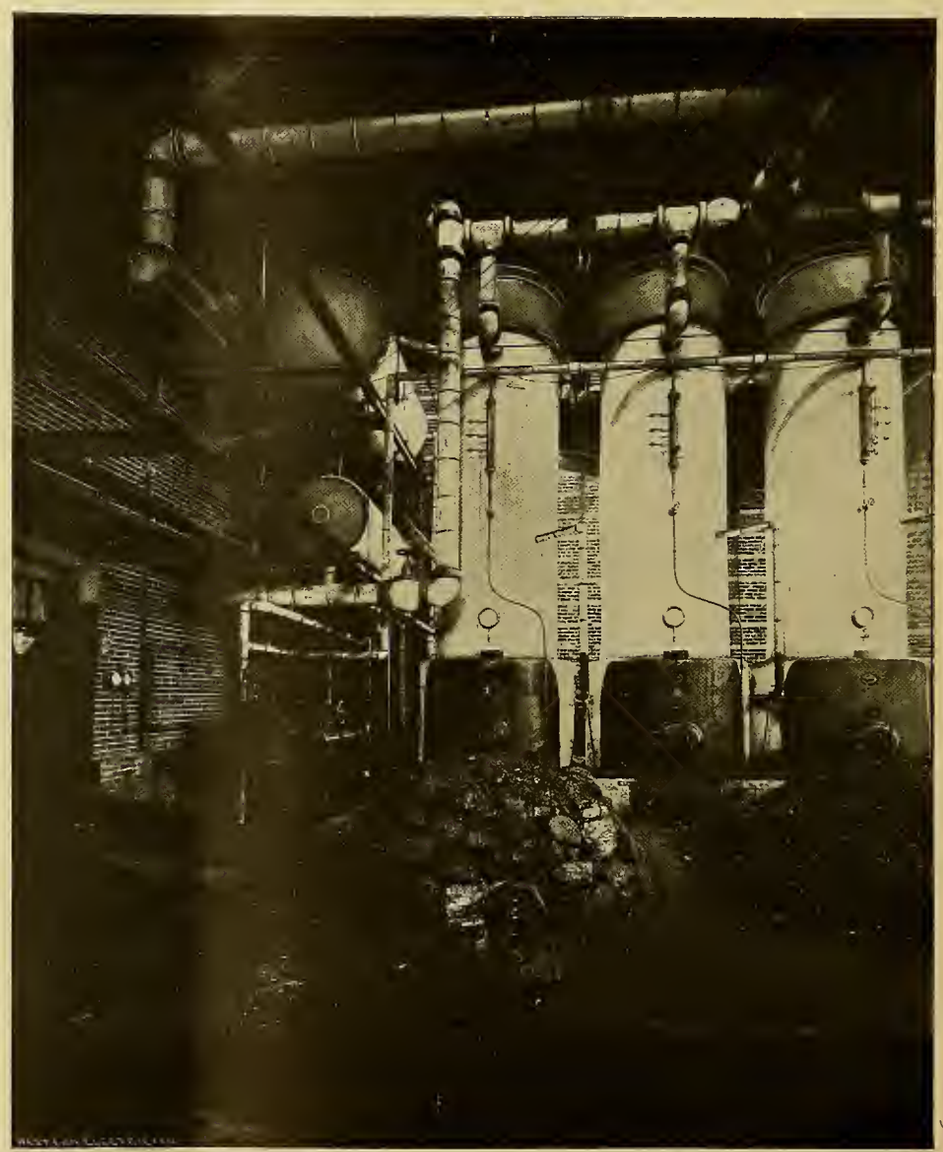


FIG. 3. COMPACT CENTRAL STATION.—EXHAUST STEAM HEATER, LIVE STEAM PURIFIER, PUMPS, BOILERS AND CONDENSERS.

method of commutation may not be out of place at this time. As is usual with open-coil constant-current machines relying upon their high self-induction to prevent disastrous cutting by sparking, the dead spaces between the commutator blocks are wide. In the earlier types of this machine these spaces were either left vacant or were filled in with some solid insulating material. In the former case the brushes were apt to chatter, and in both cases they behaved badly with the tool when it was necessary to put them on the lathe to turn them down. A very simple and effective remedy for both troubles was found by introducing into this air-gap an intermediate narrow block of copper, insulated, of course, both from the shaft and from the adjacent commutator segments. As to the method of commutation, there are in this machine eight armature poles and only six field poles, but by the method of commutation two of the armature coils are always dead, the connections of the coils being arranged according to the diagram, Fig. 7.

Coils 1 and 5 of the outside commutator are in series and 3 and 7 dead, while 2 and 8 of the inside commutator are in multiple series with coils 4 and 6. To this commutator a two-phase current having 6,600 periods per minute is delivered, and to the line a direct current of 6.8 amperes at 50 volts.

But the most interesting feature of this machine is its method of regulation. While Sayre in England and Ryan in this country have been trying to overcome or nullify armature reaction, the designers of this apparatus have taken the bull by the horns and converted it into a useful agent. By a bold step they have striven to magnify this armature reaction to the highest extent, and thereby have obtained a characteristic beyond the bend, which is essentially a vertical straight line, which means exact regulation within wide limits solely by means of armature reaction. Then in addition to this, by means of the unvarying field excitation, they have extended this regulation so that if the dynamo be absolutely short-circuited the rise of current will not exceed one-tenth ampere.

The switchboard needs no special mention, except that it is a handsome marble structure equipped with plunger switches for the alternating current, and operates the generators in multiple except during light loads.

All of the steam piping in the establishment is extra heavy and provided with valves and fittings so as to be interchangeable, enabling any boiler to be put on any engine. The pipes, boilers, heater and purifier are covered with crimp asbestos paper furnished by the New York Air Cell company, and are well protected against radiation losses.

In the boiler room it was found that there was but 1.5 square feet for each rated horse power of steam generating plant, including all auxiliaries except the stack. In the dynamo room the following figures obtain: Each 75 light arc machine occupies four feet by five feet six inches floor space. Each 75 kilowatt unit, including the 150 horse power engine, dynamo and transmission, covers a floor space of 10 feet nine inches by eight feet six inches, or 91.3 square feet—1.2 square feet per kilowatt—and the dynamo room as a whole, including engines, dynamos, transmission, switchboard and all accessories, as well as ample clearance space, is on a basis of but 2.6 square feet per indicated horse power.

Work is being pushed on the electric light system for Grand Forks, B. C.

Future of the Self-propelled Vehicle.

By Clinton E. Woods.

As the use of electricity develops, its possible sub-division into local domestic uses, in many ways, are beyond man's present power to conceive. It opens up new changes in conditions; creates new desires in mankind, which in turn set inventive genius to work, and so on ad infinitum; and now on the eve of another great change in our domestic customs, the one of highway and byway conveyance, by the innovation of the horseless vehicle, we cannot but feel intensely interested as to the morrow.

Bicycles came and made a great change, of a very permanent nature, notwithstanding the fact that the major part of the people believed them a fad. They, however, disturbed no existing condition, but rather created a new one, with accompanying pleasure and convenience; but now with the horseless age staring us in the face, it not only means a new creation but a far-reaching disturbance in already exisiting conditions, and people already inquire eagerly into its possibilities and advantages, its convenience, pleasure and utility.

Long use and association with other means of transportation than by animal power have brought this about by unconsciously giving birth to a strong desire and preference in the minds of the public for mechanical conveyance. The bicycle was one of the strongest factors in opening the way for the new era before us, because of its new mechanical conception and place of operation.

What will be the benefits in general of the self-propelled vehicle? With it will come an independence and rapidity of motion delightful to anticipate. The tired, hot, sweaty, overdriven, irritable horse will no longer annoy us; there will be a great economy of time from point to point; much less congestion in street traffic, as each vehicle will only occupy, on the streets, about half the space now taken up; a great reduction of cost for miles traveled per annum, because there will be no horses to feed and groom when vehicles are idle; great reduction in barn and stable room, with a proportionate low cost of rental; absence of noise and clatter on the street, which will of itself be a great boon to the over-wrought nerves of this high-strung and sensitive generation; an improved sanitary condition of the streets, of vast importance to the health and finances of every city; a refinement of pleasure riding, which the presence of an animal destroys in many objectionable ways, and an independent control of speeds, avoidance of accidents and dexterity of progress not obtained by the use of animal power.

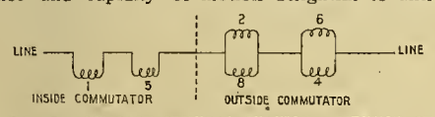


FIG. 7. COMPACT CENTRAL STATION.—METHOD OF COMMUTATION.

To the inquiry as to new departures and possibilities, in a commercial and practical way, the horseless vehicle holds out great commercial inducements aside from the novelty of the moment. In the first place, public liveries may be established in the choicest residential districts of any city, as objections, arising from disagreeable odors and noises surrounding the horse livery stable, will no longer exist, and the space occupied will be comparatively small, making the investment for property or rental at such a point well within practical measures, because there will be required no room for stables, hay lofts, feeding facilities, harness room, and, best of all, no oats and attendants when vehicles are not in use, at the same time putting such an enterprise into close contact with the best trade to be secured.

Another great innovation will be the establishing of interurban transportation lines by the use of these vehicles, which will work in harmony with the regular standard and street railway suburban service of cities, thus making a complete conveyance to every man's door, and it would not be surprising even to see such lines in direct competition with the regular street railways.

In the service of merchandise delivery these vehicles will work a great change by their rapid and noiseless operation, and one vehicle will be able to do twice the work in the same time as those in present use. The coupe, cab and hack conveyance will be twice—yea, thrice—as rapid, surer, safer and more comfortable; a closed carriage with electric lights and heating apparatus in its interior means the acme of comfort.

The United States government is already considering the equipment of its mail wagons in large cities with means of self-propulsion, and it is reported that an experiment of 20 or 40 wagons is to be made within the coming year. The large express companies are also investigating the matter, and municipalities are most anxious for this form of propulsion on their ambulances and patrol wagons.

In and around the city of Paris to-day some 2,000 horseless vehicles are in service, and four large concerns, there engaged in the manufacture of these carriages, are unable to meet the demands made upon them by running their factories night and day. In London many of these vehicles are already in use, and quite a few are to be found in Germany. The foreign articles are, however, clumsy in most instances, and it has remained for the American inventor to put the artistic finish to these vehicles and to simplify the mechanical power equipment. A vehicle that is simply a machine is not acceptable to the people in this country who are users of fine carriages.

Municipalities have little recognition, at the present moment, of the vast importance it means in expense saved on street repair and sewerage maintenance to them; rubber tires and absence of horses' feet, which pound like so many iron hammers and dig like so many iron picks on the roads and streets, will decrease the cost of repair fully 75 per cent. The improved sanitary condition of the streets will not only make them clean and healthy, but leave the sewers free, and make heavy stone pavements unnecessary. Macadamized or asphalt will be used instead, and two miles can be built for the present cost of one. The expense of street cleaning and sweeping will be reduced to a minimum, and a means of local conveyance established most delightful to anticipate. In addition to this, with horses removed, the same number of vehicles will only occupy one-half the space on the street, thus avoiding much congestion. All of this concerns not only the owners and users of these vehicles, but every citizen and every taxpayer in every large city.

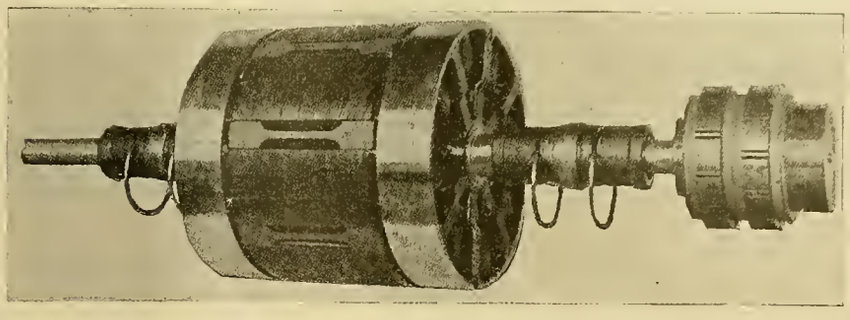


FIG. 5. COMPACT CENTRAL STATION.—ARMATURE FOR 75-LIGHT DIRECT CURRENT ARC MACHINE.

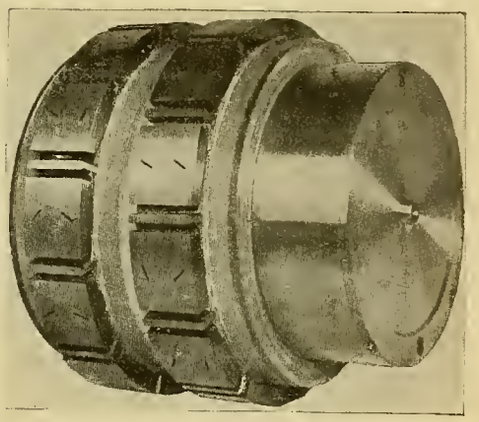


FIG. 6. COMPACT CENTRAL STATION.—COMMUTATOR.

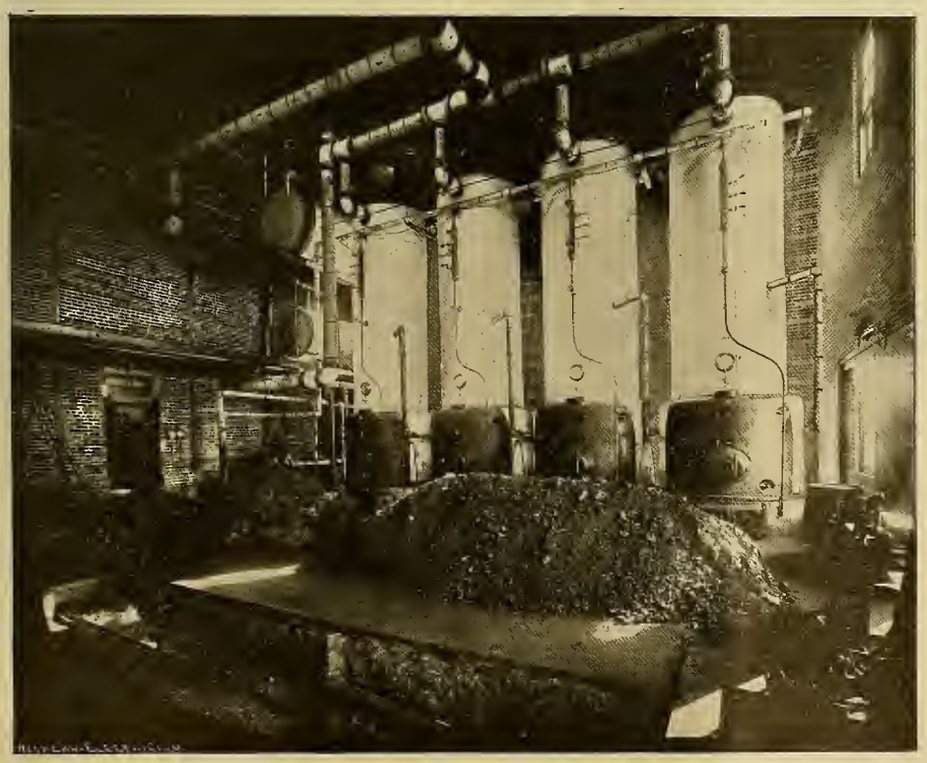


FIG. 2. COMPACT CENTRAL STATION.—BOILER ROOM.

The cost of making roads especially adapted to this form of vehicle, in country districts, is not expensive if horses are kept off of them, and as speeds are easily obtainable up to 20 and 25 miles per hour, the benefits to be derived in this direction can easily be recognized.

In most large cities the present condition of the street is favorable for the operation of these vehicles, as they will run through and over rough and uneven, soft and muddy places without any difficulty whatever. Where heavy grades or hills have to be climbed a differential gear has been designed that can be thrown in while the vehicle is in motion, multiplying the leverage on the wheels from six to 12 times, as desired. But with the introduction of these vehicles in conjunction with bicycles a great and rapid change in roadways will be demanded in the country districts, probably to such an extent that turnpikes will be constructed for these two methods of conveyance to run on, exclusively, at a toll of so much per mile, on which no horses will be allowed. The cost of maintenance will be very low, as it is the feet of horses constantly digging into the roads that cause their rapid depreciation. With such roads through the country, from town to town, much of the personal pleasure transportation will be done with the self-propelled vehicles.

Charging stations for the batteries will be equipped by electric light companies in every town, and we will exchange our batteries anywhere for a freshly charged set, as they are so arranged in trays as to be instantly removed and duplicated with a new set, or they can be charged remaining in the wagon, if time permits. Current from an arc light circuit or from an incandescent circuit can be used; in fact, wherever there are electric lights, a gentleman or firm running these vehicles has only to have the wires from the lighting circuit brought to his carriage house and to attach them to his battery when necessary. They can be charged in as short a time as two hours, or can

be adjusted to consume 12 to 15 hours over night in charging, as desired. Firms using a number of vehicles can put in a small gas engine and dynamo and charge their own batteries, or a private individual can put in the same equipment and not only charge his batteries but light his house and barns from the dynamo direct or the storage batteries, which can be interchangeable for lighting or use in the vehicle if it is not desired to run the engine nights. The expense of running a vehicle so charged, for four persons, will not exceed one-half cent per mile.

Many questions touching the practical side of self-propelled vehicles have been asked the writer by all classes of people touching upon the initial cost, cost to operate, method of controlling, possibilities in its application to existing vehicles, best forms of power and what changes it will make in future conditions of road transportatian.

Touching the cost of the vehicles first, and considering fine carriages only, a stanhope carrying two people, finished in the best manner of the carriagemaker's art, will cost about $1,000, as against the ordinary stanhope costing about $500, and an additional $300 for such a horse as is used, and about $150 for the harness, thus making the cost of the rigs about equal. A mail phaeton, carrying four people, will cost about $2,200. This is a strictly first-class carriage in every detail; an ordinary vehicle of the same kind will cost from $1,000 to $1,600, horses about $600, and harness about $300, thus making little difference in the cost of either complete. A fine private brougham will cost about $2,400, and a cheaper one can be built for $1,800; a doctor's phaeton for about $1,000; and a large brake, carrying 12 to 14 passengers, for $3,000. Each of these vehicles will be equipped to run 40 miles with one charge of battery, on level, hard roadways; hills and very windy weather will reduce the mileage capacity from 10 to 25 per cent., according to size and strength. The cost of charging a set of batteries, carrying two people, is 40 cents, and in one, carrying four people, 60 cents, In one case, one cent per mile; in the other, 1½ cents per mile for every two passengers over this. The weight complete of a vehicle like the stanhope, for two people, will not exceed 1,050 pounds, and a vehicle for four people will not exceed 1,600 pounds, and so on, in proportion. The long, much abused and misunderstood storage battery is no longer an obstacle in the way of success. Means devised for utilizing it and improvement in the battery itself have already reduced the weight to one-half of what it was a year ago. People must not expect to put their horses inside of the wagon and have nothing to show that such a thing has been done except their absence.

The idea that storage batteries were prohibitive for use in a vehicle because of their weight was gained from the early and crude application to street cars. Experiments came to a standstill, and development for this work ceased because the first cost of a trolley equipment proved to be much the cheaper.

The horseless vehicle is not a thing which has grown up mushroom fashion, as some people seem to think. From time to time inventors have sprung up with so-called horseless carriages designed to operate on ordinary roadways and streets, all of which have died a natural death because of their crude and mechanical appearance, for one thing, and because of lack of interest in such things by the general public, for another. Their conceptions were in most instances the work of a crank inventor or amateur electrician and mechanic. In order to understand the necessary design of vehicles, conditions of operation must be studied from a strictly engineering point of view, and an equipment designed to meet these conditions, followed by a vehicle so designed as to accommodate such an equipment. Some people seem to think, because a wagon will run by means of power propulsion, it should be run 100 or more miles on one charge of the batteries. This will be demanded only by heavy transportation in freight vehicles, but is

FIG. 1. MODERN GEAR PLANT.—GEAR PLANT OF GENERAL ELECTRIC COMPANY, AT LYNN.

wholly unnecessary in all general classes of pleasure vehicles. Our best locomotives on railroads hardly give that length of operation. Coal and water have to be taken on quite frequently. A careful inquiry among all classes of vehicle drivers and owners divulges the fact that a distance of over 30 miles per day is rarely needed in the operation of any vehicle. Drivers of merchandise or delivery wagons cannot deliver goods from their wagons over an area greater than this per day, except in a special or isolated case. The average

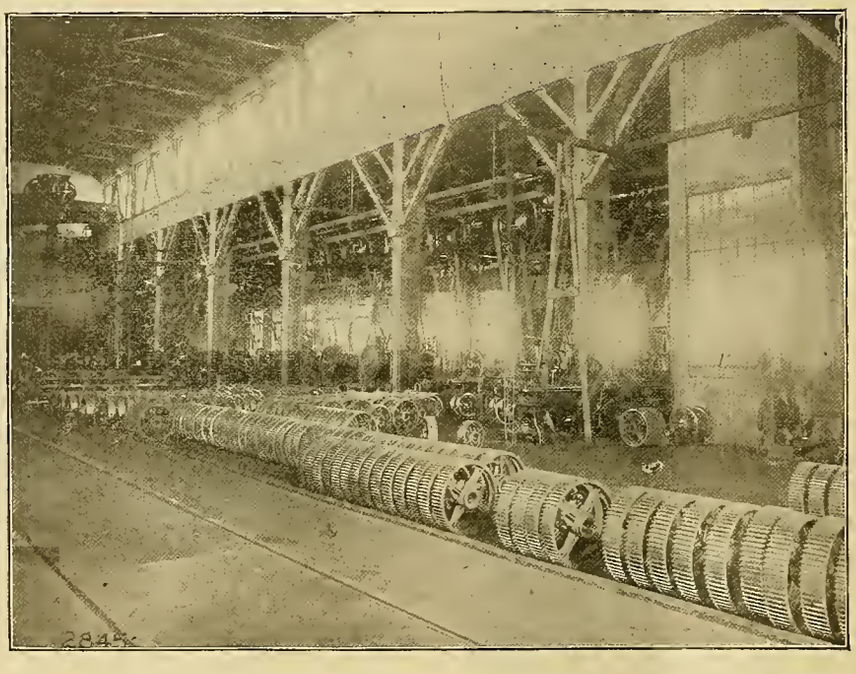


FIG. 2. MODERN GEAR PLANT.—INTERIOR OF GEAR PLANT, SHOWING GEARS READY FOR SHIPMENT.

brougham, cab or hack does not exceed 25 miles per day in its hardest day's work. Livery rentals rarely exceed 2½ hours, a possible 25 miles ride, and what private individual cares to ride for pleasure more than 30 miles at a time? Therefore, why is it necessary to put in an excessive battery equipment to cover long distances, when the short time of charging or ease of duplicating the freshly charged sets is so well arranged? It is proper to mention here that the time of operation is in proportion to the speed. For instance, a wagon will run 36 miles in three hours, at 12 miles per hour, or 36 miles in six hours at six miles per hour, and so on. Another vital question, and one which only can be answered by data from the operation of the same things in other directions, is the question of depreciation in the batteries and motors of vehicles. It must be understood first that in pleasure vehicles the best possible workmanship is incorporated; ball-bearing axles are used for reducing the friction to a minimum, and rubber tires are also used to preserve the mechanism and the ball-bearing axles and the batteries from any violent jar. The vehicle itself, under such conditions, will last much longer than the ordinarily constructed vehicle drawn by horses. It is a well-known fact that the depreciation of a thoroughly first-class motor does not exceed 10 per cent. per annum, and the depreciation of good storage batteries well taken care of will not exceed the same figure.

Now we come to a question that is one of the most interesting of all, and that is the form of motive power best adapted to the propulsion of vehicles on ordinary roads, and it lays, of course, between the equipment of a vehicle with electrical means of propulsion, or one propelled by gas or petroleum motors or engines or a combination of both of these factors. It is undeniable that some considerable effort has been made with the gasoline or hydrocarbon motor equipment, and from an engineering point of view, with fairly good success, but it has so many objections surrounding it for use on fine carriages designed for only personal and individual use that public sentiment seems to be decidedly against it. Among these objections may be mentioned: Absence of refinement and artistic beauty in looks; the intense concentration of heat in the engine itself, which in most cases has to be dissipated by water jackets constantly refilled as the water heats up; disagreeable odors from the burned oil; objectionable noises of a mechanical nature and also from the puffing exhausts; visible vapors or smoke from these exhausts; excessive vibrations imparted to the vehicle from the engine's reciprocating motion; mechanical complications, as the speed has to be controlled by variable gears, etc. The efficiency of these motors also depends upon their working at full load and they have not the factor of flexibility desired. In other words, a motor of two horse power will not work beyond that. If it comes to a hard place, where more power is required, it simply stops. Examining this point for a moment, a horse power is not, as many people suppose, what one horse pulls; its equivalent in mechanics is 33,000 pounds raised one foot high in one minute's time, and in climbing heavy grades and going through bad roads, one horse oftentimes makes an effort equal to two or three mechanical horse power for a very short period of time. With an electrical equipment we can perform exactly the same thing; any given size of motor and battery can be momentarily worked up to two and three times its normal rated power. That is, a two horse power motor can be made to develop four or five horse power for a short period of time, in climbing a bad hill or starting in a bad place, thus developing the same flexibility of power application as exists in the use of a horse. With a gas engine nothing of this kind can be accomplished. The electrically equipped vehicle does not have any of the objections already enumerated that exist in the simple gas engine equipment alone. Its control of speeds is not mechanical, but is purely an electrical proposition. As regards the weight between the two vehicles, notwithstanding all talk to the contrary, the gas engine equipment weighs as much as the electrically equipped vehicle does. In all fairness, however, it is to be said that this criticism of the gas engine equipment is confined to high-grade carriages for both public and general passenger use and private family use. The writer believes, however, that the gas engine has a field of its own on wagons for heavy freight transportation and trucking, as, of course, it is understood that the refinement demanded in carriages is of no moment in freight and transportation work on road vehicles.

This is done by providing it with an auxiliary flexibility not inherent in itself, or, in other words, by combining the gas engine, storage batteries and electric motor into one unit of power equipment, thereby generating the current in the wagon itself for the batteries and motor. This system is known as the Patton motor system, and has already been applied to motor cars, and at the present moment is being applied to six-ton express wagons. In the wagons being built two normal six horse power driving motors are used, one geared to either hind wheel, one seven horse power gas engine, and one 6½ horse power generator, besides 44 cells of batteries, all of which weighs 2,500 pounds. The wagon itself weighs 2,500 pounds and will transport a load of four tons at a speed of seven miles an hour, distance being limited only when gasoline or petroleum cannot be secured. The maximum available power for momentary work on grades and bad places to start is 20 horse power when the batteries and engine are used together, the motor being capable of standing 80 per cent. overload for short periods of time.

The data of four different equipments using straight storage batteries that are being perfected for the market by another concern have also been handed me. These equipments are designed for fine pri-

DATA OF STANDARD VEHICLE EQUIPMENT USING TWO MOTORS PER VEHICLE.

	No. 1.	No. 2.	No. 3.	No. 4.
Weight of wagon, only	276 lbs.	560 lbs.	850 lbs.	1,556 lbs.
Weight of batteries	484 lbs.	660 lbs.	880 lbs.	1,144 lbs.
Weight of two motors	140 lbs.	180 lbs.	220 lbs	300 lbs.
Complete wt. of vehicle	900 lbs.	1,400 lbs.	1,950 lbs.	3,000 lbs.
Load to be carried	400 lbs.	700 lbs.	1,050 lbs.	1,050 lbs.
Horse power required in each motor	.75	1.12	1.67	2.5
Speed of motor, revolutions per minute	1,000	1,000	1,000	1,000
Number of battery cells	44	44	44	44
Ampere-hours capacity (three hours' discharge)	40	60	90	135
Maximum speed of vehicle (miles per hour)	12	12	12	12
Time of running (hours)	3	3	3	3
Minimum speed vehicle (miles per hour)	3	3	3	3
Hours' time of running	12	12	12	12
Average mileage capacity	36	36	36	36
Diameter of rear or driving wheel	32 "	36 "	36 "	36 "
Diameter of driving gear	14 "	19½"	19½"	19 "
Diameter of motor gear	2 "	2½"	2½"	2½"
Diameter of front wheel	28 "	32 "	32 "	32 "
Diameter pneumatic tire	2½"	3 "	3½"	4 "
Size of rear or driving axle	1⅛"	1⅝"	1⅝"	1⅝ "
Size of front axle	1 "	1¼"	1⅜"	1⅜ "
Width of battery in vehicle	24 "	28 "	28 "	28 "
Length of battery in vehicle	26 "	30 "	36 "	42 "
Height of battery in vehicle	9½"	10½"	10½ "	10½"

vate and public light carriages. I give the figures in full for the benefit of those interested. One large carriage concern has already commenced the building of vehicles to use the equipment, which is furnished in its entirety. The table shows about what the vehicle should be built to weigh, independent of the equipment, which is to include controller, reversing switches, brakes and part of the steering gear when demanded, in addition to the motor and batteries. This will relieve the carriagemakers of all expensive experimental work and enable them to interest themselve in the proposition at once.

In addition to the service demands of ordinary vehicles, as here outlined, it may be of interest to mention some actual figures regarding possibilities of economy in public livery stables which the use of an electrically equipped vehicle will insure. The stable cited is located in a large city and operates 30 landaus or hacks and a few broughams commonly called coupes. To operate 30 vehicles on an average six hours per day required the keeping and maintenance of 100 horses. The cost of maintenance on this point averages a dollar a day per head, making the fixed charge for keeping the horses $100 a day. This, of course, includes attendants, shoeing and rental, but did not include interest on an investment of $50,000. The total mileage capacity available under these conditions did not exceed 25 miles per day per vehicle. The depreciation in horse flesh was estimated at 20 per cent. per annum, which was afterward stated to be an extremely low figure. Thirty carriages of a similar character, equipped electrically, would have a first cost of about $60,000; the actual cost to operate them for power—that is, electric current as it can be bought from city mains which furnish electric light and power—would be $17.50 to operate the 30 carriages six hours per day, giving a mileage capacity to each carriage of 40 miles. The cost of attendants would be not to exceed four men (drivers are not included in this case, neither were they in case of vehicles drawn by horses); these men would probably cost $8 a day, making a net cost of operation of $25.50 per day, as against $100, using horses. About one-third of the space would be required to house these vehicles, as compared with a horse stable, and in addition to this it must be remembered, whether business is good or not the fixed charge of keeping a horse remains the same, while the cost of operation in electrical equipments, otherwise than attendants and interest on investments, is exactly in proportion to the number of miles the carriage runs. The cost of depreciation on these vehicles will not under any circumstances exceed the figure mentioned for horses. This means nearly 50 per cent. increase in mileage capacity at about one-third of the cost of investment; also the advantage of more rapid transportation, as the vehicles are geared up to something like 14 miles per hour, and the possibilities of an entree to the finest residential districts of any city. The cost of current would be reduced by nearly one-half where a small gas engine and dynamo are installed in the livery, enabling the concern to generate its own current for the batteries.

Modern Gear Plant.

A conservative estimate places the number of electric railway motor gears in daily use in the United States alone at not less than 50,000, and as the average life of the gear is about two years, a yearly output of from 20,000 to 30,000 is necessary for renewals alone, exclusive of those required for new motors. In the pioneer days of the electric street railway the cast-iron gear and pinion of gun-metal were used exclusively, but to-day the standard motor gears are of cast-steel and the pinions of hammered steel, while the teeth are accurately cut from the solid stock by machines as perfect in their adjustment and performance for their work as those which cut the more delicate gears of higher class machinery. The change from cast-iron to steel has resulted in a reduction of 60 to 70 pounds in the weight of the gears, while their life has been very materially increased. A steel gear will wear more than twice as long as a cast-iron gear, and while with the latter type breakage was a common occurrence, with the steel gear it is practically unknown.

The General Electric company established some time ago at its river works, Lynn, Mass., a plant for the manufacture of gears and pinions, equipped with cutting machinery of modern character. The exterior of the establishment is shown in Fig. 1. In this building is an extensive foundry for the gear blanks, as well as the gear-cutting shop. The former is equipped with overhead traveling cranes driven by electric motors, furnaces for the molten metal, core ovens and modern appliances of all kinds for the manufacture of steel castings of the highest grade. The great difficulty encountered in making steel castings—the tendency to secure blow holes, draws and cracks—has been overcome in this foundry. After a long series of experiments, the General Electric company perfected a process which now enables the foundryman to produce steel castings which are as practically perfect as if of hammered steel. Indeed, it may be said that in this gear foundry the manufacture of sound steel castings has reached an extremely high state of development, for not only has the question of soundness secured practical perfection, but the strength and wearing qualities have been the subject of long experiment until the steel produced possesses both in a striking degree.

Fig. 2 shows an interior view of the shop, that side devoted to the milling machines, gear cutters, key-seating machines, special drill presses for drilling the bolt-holes in the gears, and others. Some idea of the extent of the industry may be gathered from the number of gears in the foreground standing ready for shipment on order or removal to the stock room. Fig. 3 is a nearer view of some of the special drill presses, milling machines, etc., with a lot of gears in course of preparation for the teeth-cutting machines.

The process of manufacture of a pinion is illustrated in Fig. 4, showing the pinion forging, the pinion blank, milled, bored and seated, ready for the teeth to be cut, and the finished pinion ready to ship. Fig. 5 shows a steel gear, bolted together and machined, with part of the teeth cut. These teeth are cut from the solid stock by specially made cutters, themselves designed after exhaustive experiment. The machines used are both elaborate and expensive and are of unusually heavy design and accurate workmanship. They are all fitted with ingenious devices for producing uniform teeth. The pinions are cut from the best hammered steel forgings, and the teeth are cut with the same care as is taken in the cutting of the gears. Both pinions and gears undergo a rigid inspection before shipment.

The question of age of gears has not, perhaps, received from street railway managers the attention it deserves. In the life of gears there is a distinct difference between the extreme life and the proper economical life. There is a point in the age of gear and pinion at which it becomes more economical to consign them to the scrap heap and to use a new gear and pinion than to retain them in service. The question is a nice one, and a series of efficiency tests has recently been carried out, showing that a worn gear and pinion require about 400 watts more energy than a new gear and pinion.

FIG. 3. MODERN GEAR PLANT.—DRILL PRESSES, MILLING MACHINES ETC., IN GEAR PLANT.

Additional Niagara Power for Buffalo.

The power transmission line from Niagara Falls to Buffalo is now undergoing a considerable increase. The demand for power from Buffalo, it is said, has within the last few months grown beyond the capacity of the line first put up. The three wires now strung on the poles will shortly be duplicated.

A new order for cable, as well as for transformers, has been placed with the General Electric company. The cable will be of special manufacture, insulated to stand the ultimate pressure of the line, which will be 22,000 volts, and a considerably higher pressure before leaving the works. At first 24,000 feet of this cable will be used for that part of the transmission line within the city of Buffalo. The order for increasing the transformers covers seven of similar size and design to the three already installed in the transformer house of the Niagara Falls Power company. These 10 transformers are the largest ever built, making a total step-up transformer capacity of 10,000 horse power. They are of the air-blast type, and will stand in rows of four upon the air-tight chamber, whence the air will be forced through the ventilating spaces in the transformers. It will be remembered that the two-phase current at 2,200 volts passes from the 5,000 horse power generators in the power house to the transformers. In these it is not only increased in pressure but changed in phase, the current issuing from the transformers three-phase current at 11,000 volts. This pressure will be adopted until it becomes necessary to increase it, when it will be doubled and be delivered to the transmission lines at 22,000 volts. On its arrival in Buffalo it will be delivered to the step-down transformers of the Cataract Power and Conduit company, which controls its distribution there. The electricity will be transformed down to different pressures for distribution over a city network to different points for a variety of purposes, being used directly in induction motors, a number of which will probably be installed in grain elevators.

Several step-down transformers will also be placed in the station of the Buffalo General Electric company, and from these three-phase current, converted into direct current in rotary converters, will be utilized for lighting purposes and small motors.

The Buffalo Railway company is also increasing its step-down transformer and rotary converter capacity in its Niagara street power house. In addition to the two 500 horse power converters already in operation, the General Electric company has built two others of similar capacity and construction. These will bring the total converter capacity in the station up to 2,000 horse power. To supply these necessitates the installation of three additional step-down transformers in the transformer house between the station and the canal. These will be of about the same capacity as the three already there—each of 275 kilowatts, reducing three-phase current from about 10,500 volts to 375 volts for delivery to the alternating current side of the rotary converters, in order that it may issue direct current at 550 volts, at which pressure it is delivered to the bus-bars of the station switchboard.

Western Union Claim Against Government.

Attention has already been directed to the fact that when John Wanamaker was postmaster-general he issued an order fixing the rate to be paid by the government for the transmission of telegraphic messages at one mill a word. Against this the Western Union Telegraph company protested throughout the administration of which Mr. Wanamaker was a member, and at the close of his term of office sued the government in the Court of Claims to recover the amount of money to which it thought it was entitled for the business transacted during the existence of that order. The matter was referred last June to First Assistant Postmaster-general Heath, as master, for examination. In September he reported that the telegraph company was entitled to recover $258,869.84. This report was confirmed by the court last week and judgment given the telegraph company for that sum. The decree, however, expressly stipulates that nothing it contains shall in any manner prejudice the right of the government in case of any other litigation respecting telegraph rates to assert its rights to fix the rates for government business.

Fig. 4. Growth of a Pinion.

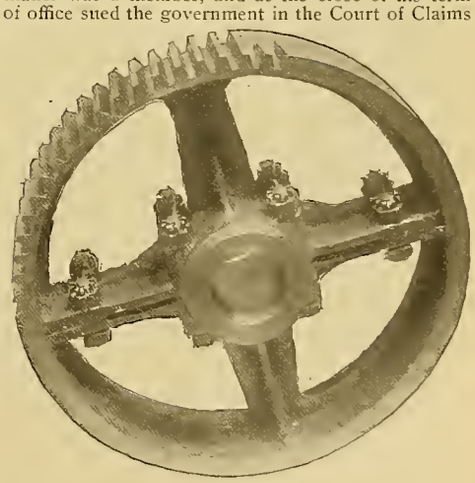


Fig. 5. Gear Under Way.

MODERN GEAR PLANT.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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Thomas Jansen, being duly sworn, deposes and says that he is a resident of the city of Chicago, in the county of Cook and state of Illinois, and that he is the foreman of the printing department of the Electrician Publishing company, the publishers of the Western Electrician; that he was present at and superintended the printing of No. 24 of Vol. 20 of the Western Electrician, issued on June 12, 1897, and that there were printed by actual count 20,000 complete copies of said Western Electrician of the volume and number above specified. And further this affiant sayeth not.

THOMAS JANSEN.

Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

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Action upon the proposed lease of the West End road to the Boston Elevated Railway company by the State Board of Railroad Commisisoners, which is announced elsewhere, has been hailed with delight by the people of Boston, not only because it was believed that the formal approval of this measure by the board would jeopard the interests of the people, but because it is taken as an indication that the commission is independent of the baleful influence of the corporations that are so much dreaded throughout Massachusetts. There is probably no section of the country where corporations are so powerful as in New England, and outside of Kansas there is no state in which they are more generally disliked as in Massachusetts. Yet the corporations thrive and prosper, giving good service and reaping their reward as they go along; but the feeling against them is growing stronger each day, unreasoning and unreasonable as it is, in spite of all that has been done by the corporations, especially the electric railway companies, in developing New England.

Chicago street railway corporations have been brought face to face with the question of providing fenders for trolley and cable cars. Thus far they have been unable to agree upon a form of guard that commands the approval of the city officials charged with executing the order of the Council. The street railway companies frankly admit that they have little hope of securing a fender that will serve as an efficient protection to pedestrians and children, as they know of none now on the market that can be so described. Such an admission is rather discreditable to American ingenuity, unless it be true that the street railway companies have discouraged invention and improvement in this line. It seems hardly credible that an honest and persistent effort could have been made without success, since the danger attending the increase in speed of mechanically propelled cars has been recognized.

To an unprejudiced observer it seems as if the only thing for the street railway companies to do is to devise a fender or improve existing fenders until an efficient form has been developed. This journal has repeatedly urged the necessity of giving attention to this question, and also the problem of controlling trolley cars, which is probably of more importance than that of providing fenders. It is generally understood that electric street railway lines are poorly equipped for braking, and where more than one car is operated there is constant danger of accident, as the train cannot be stopped quickly by hand-brakes alone.

Steps should be taken by the street railway companies to remedy these defects in the present service.

Congress will again be asked to take up the question of establishing telegraphic communication between this country and Hawaii. In the 54th Congress a bill was introduced authorizing the Pacific Cable company of New York to build the cable. After being reported favorably by the committee on commerce in the House it was sent to the postmaster-general for a report. This document has not as yet been given out, but it is said that it will be presented to Congress soon after it assembles. It is announced that the government has completed a survey of the route as far as the Hawaiian Islands, and if the bill is passed at the coming session the cable will be in operation in 1898. The company announces that its proposed cable will connect San Francisco with the Hawaiian Islands near Honolulu, and that extensions from the Hawaiian Islands will be made to Japan and Australasia. The surveys for the cable between the coast of California and the Hawaiian Islands are highly satisfactory. Deep-sea surveys in the southwestern Pacific show a remarkably even bottom, much more favorable than the older charts indicated, many supposed shoals having been expunged from the admiralty charts. It will require over 9,000 miles of cable to connect the United States with the Hawaiian Islands, Japan, China and Australasia.

The prospect of establishing a British cable has been pushed so vigorously of late that it seems to have aroused the promoters of the American enterprise to a realization of the necessity for action. It is the desire of the British government that the United States shall authorize a British company to land a cable on one of the Hawaiian Islands, this cable to connect Canada and Australia. Aside from the conflict of interests controlled by Americans, such authorization is opposed by the French government on the ground that the laying of a cable with British capital would place Great Britain in control of a telegraphic system reaching around the entire world, and that, in the event of war, before a message could be transmitted the British government's consent would have to be obtained. It is anticipated that the present administration will see to it that any cable connection that may be established between this country and the Hawaiian Islands shall be directly controlled by Americans.

Enthusiastic independent telephone men announce their intention of invading Greater New York and engaging the Bell interests in active warfare in the stronghold of the old company. While the wisdom of such a policy may be questioned, the earnestness and confidence of the independent interests command admiration. Heretofore the outside companies have confined their efforts to the smaller cities and towns that had not been supplied with telephone service at all, but of late there has been a tendency toward more pretentious effort. The almost uninterrupted success of the independent companies has undoubtedly lent confidence to the promoters of these projects. Generally speaking, the business community has given valuable assistance to the independent movement. It has been recognized that the Bell interests have restricted the use of the telephone and have not made it as valuable an auxiliary to the subscriber's business as it might have become under more liberal policy. But in the large cities where the Bell company is firmly established it has been generally considered an unprofitable task to attempt to dislodge it. In cities like Detroit, Grand Rapids and St. Louis the independent movement has proved very popular. In the last named city at the present time the preparations for introducing an independent service are being carried on, and it is reported authoritatively that the new concern has already more subscribers than the old company. It may be that Chicago and New York will, in turn, become the scene of a telephone war. The prospect of such an event will be viewed with satisfaction by the subscribers who have been bled so long and systematically by the Bell company, and it is not to be expected that they will discourage the idea.

Investigation of the causes of the great conflagration in London recently disclosed a condition of affairs that can scarcely be appreciated in this country. It seems highly incredible that the commercial metropolis of the world should be thus exposed to destruction by fire in spite of the safeguards that modern science has provided. In the city of London, it is said, there are but 300 fire-alarm boxes, whereas in New York, which is not a model American city by any means, there are more than 10 times that number. In American cities any citizen can turn in an alarm, but in London it seems very few persons care to assume the responsibility, and, as a rule, notify a police officer if one can be found conveniently. In London some of the alarm boxes have keys; others have glass fronts that must be broken before an alarm can go. An alarm being turned in, it goes to the nearest station or engine house, and only that company turns out and goes to the scene, as there is no comprehensive system of communication between the several fire houses. There is no such thing, either, as ringing a second or a third alarm from the nearest fire-alarm box. While the insufficiency of the London fire-alarm system is aggravated by the fact that London has only about one-tenth as much telegraph service as New York for communicating alarms of fire, the difference between the fire departments of the two cities is even more intensified by the theory of London firemen that when an alarm is sounded, after all delays and obstacles are overcome, it will not amount to much, and that, presumably, one fire-engine company can extinguish it. About five minutes' time, on the average, is lost in getting the engine started, in lighting up a fire, and in making the necessary preparations to respond to the call. If, as generally happens, the fire call responded to does not amount to much, all goes well, the fire is extinguished and the company returns; but if, on the other hand, the fire proves to be a serious one, then telephoning is begun at a lively rate for the assistance of other companies, and meanwhile the flames are spreading and gaining headway. Such was the experience in the last great fire, and the lesson seems to have been appreciated, as the London city officials are said to be making preparations for introducing an electric fire-alarm system after the American plan.

Electrical Equipment of Testing Tank.

Considerable progress has already been made upon the construction of the model testing plant for which Congress at its last session apppropriated $100,000. It is estimated that it has cost the government over three millions of dollars in speed premiums to verify by performance the calculations of the designing bureaus of the Navy Department, but hereafter, by means of the experimental tank at the navy yard in Washington, the possibilities of the heaviest ships may be determined to a nicety. Much as mathematical science has done in other directions, it still is unequal to the solution of all the difficult questions involved in the motion of a body in water, and it is only by practical experiments that the forces at work can be rightly measured and divided among the elements of wave motion, surface friction and mechanical propulsion. Dr. William Froude of England demonstrated the fact that the performance of a model bears a mathematical ratio to the performance of a full-sized ship, and by multiplying the known functions of the miniature by its ratio to the proposed craft the possibilities and peculiarities of the contemplated vessel may be accurately predetermined.

The experimental tank now being constructed at Washington embodies the result of many years of investigation in this line and is said to be superior in design, construction and equipment to those now in service abroad. The completed structure will consist primarily of a concrete-lined basin surrounded by a one-story brick building, which is surmounted by a steel-trussed roof. The building is 500 feet long and 50 feet wide, with two small extensions for the installation of the ventilating, heating, pumping, filtering and power plants. The main basin is 370 feet long and 43 feet wide, and will have a uniform depth of 14 feet. At one end will be a narrow, shoal extension, 70 feet long and six feet wide, from which the trial runs will be started, and at the other end one 34 feet long and eight feet wide, into which the models will be carried upon the completion of the runs. The latter extension will have no special features; but at the starting end there will be a pit on each side and at the rear, for the purpose of providing convenient means for measuring the models as they float in the basin preparatory to the trials. There, too, will be a standard weighing apparatus for adjusting and standardizing the dynamometer which measures the resistance of the models or the correlative, the power required to tow them at their several speeds.

On the inner lip of the main foundation of concrete will rest the tracks upon which the carriage will travel during the runs. These tracks, of which there are two on each side of the basin, extend from end to end of the building, and are of the heaviest railroad type, and are so fastened to the foundation as to make them as nearly rigid as possible. The object of this is to obtain a surface over which the carriage, which spans the basin and tows the models, may be run at high speeds and with the least amount of jar. This is essential to the proper working of the necessarily delicate instruments that register and record accurately the various elements of the trials.

The towing carriage is also rigidly constructed and is driven by electric motors taking current from a trolley after the manner of an electric street railway. There are four of these motors. Two will be needed for runs at speeds from one to 12 knots, while all four will be required from that up to the maximum of 20 knots.

In starting the experimental runs it will be needful, in utilizing the whole length of the deep main basin, that the carriage with the model shall attain the full speed of the intended test by the time it emerges from the extension at the starting end, otherwise the length of the runs, especially at high speeds, would be materially reduced. To this end, ample power will be provided to overcome the inertia of the heavy carriage, which, when once in motion, will be kept at a uniform speed by the expenditure of very little power—its own weight contributing to that end, while absorbing whatever slight vibration may be present.

The dynamometer for measuring the resistance of the models, together with the apparatus for recording the results and the necessary fixtures and electrical instruments required, will be grouped on a platform at the center of the carriage. This platform can be raised or lowered to suit the various models.

The dynamometer consists of a very clever adaptation of the spring balance under electrical control. The model is attached by a towing rod to one end of a spring, while an electric motor moving a threaded shaft holds the other end under control. The moment the carriage starts an electrical contact, working automatically, throws the motor in gear and starts the tension of the spring and keeps it up till the pull of the motor at one end exactly balances the pull of the model at the other end; another electrical contact preserves this counterpoise. The position of the motor-moved end of the spring denotes the tension or resistance of the model; and an arm reaching up to a cylinder carrying a sheet of paper traces with a pen a record of this resistance and its variations. This cylinder, before which one of the operators sits, revolves at a fixed ratio to the advance of the carriage.

Other pens register any change of trim, settling by the bow or the stern, at regular periods, and the actual distance and position of the carriage at every interval of the run. These latter elements are checked electrically from the track and must be positive, and, by the combination with the time record, determine the actual speed of the carriage at any point in its run. The result is a diagram of simultaneous records from which everything can be read and checked with ease. The springs used will necessarily vary in strength with the speed and character of the model, and the standard weighing apparatus will be used to standardize each one before trials.

In addition to these more simple experiments arrangements will be provided for testing the functions or qualities of the models; the effects of propellers of various sorts and at different speeds, and their relations to the form of the hull about the stern where the water runs in to the screws; and also to tell what proportionate part of the total resistance of the model is due to friction of the underwater surface, what to wave resistance and what to eddies.

The high speed at which it may be needful to run the carriage—20 knots or 23 miles an hour—necessitates special arrangement at the end of the run for bringing the carriage to a halt without undue shock to the heavy mass in motion. This is to be accomplished by a huge friction brake carefully graduated in its pressure by hydraulic cylinders, and operating uniformly on each side of the carriage. When this brake is in operation it will be possible to bring the carriage to a stop from full speed within 20 feet. A supplementary or emergency brake, in the shape of an immense hydraulic cylinder, is automatically thrown into gear upon the failure of the friction brakes, and will be absolute in case of accident.

The models to be experimented upon will be as nearly as possible of a uniform length of 20 feet as an even scale proportionate to the full-sized craft will allow. For instance, a vessel 156 feet long will have a model on an eighth scale, that is 19½ feet long, while a craft 383 feet long will have a model on a nineteenth scale, or 20.1 feet long. They will be made of pine wood, accurately cut by a special machine from the lines of the proposed vessel, and then carefully measured and checked before being launched into the basin. They will then be prepared in the balancing basin prior to starting, and nicely ballasted so as to represent accurately the intended craft when she is ready for her trial.

In order to lessen the chance of disturbing draughts, the walls of the building will be without windows, light and air coming in through the glazed skylight above. The steel-trussed roof is both unique and light, and does away entirely with any obstructing supports against the walls of the building, and leaves an unbroken run for a gallery on each side, where the models may be conveniently stored after trial, and space also for a footpath from which photographs of the models under way may be taken and other observations made. The entire structure inside will be painted white and besides providing a light and convenient building for the work in hand will present an attractive appearance.

At the Navy Department it is believed that the records will be free from that jumpiness and vibration common to other tank registers, owing to the precautions that have been taken in the construction and equipment.

Duty on Electrical Apparatus In Cuba.

The new tariff of Cuba which is now in effect provides that submarine telegraph cables may be imported free of duty. The duties on electrical equipment are as follows:

Ordinary hollow glass and electrical insulators: Discriminating duty, $1.85; revenue duty, $.277 per 100 kilogrammes, gross weight; subject, however, to a tare allowance of 30 per cent.

Incandescent electric lamps: Mounted or not, $2.778 per 100 kilogrammes, gross weight; tare allowance, 30 per cent.

Wire cables: Discriminating duty, $1.947 per 100 kilogrammes, revenue duty, $0.926, gross weight.

Copper wire, or its alloys: Wire covered with cloth or with insulating covers, and cables for conducting electricity along the highway, $13.89 per 100 kilogrammes, gross weight. By "cables for conducting electricity" is meant those consisting of one or more wires of copper or of an alloy into which copper enters, whatever their thickness, provided they are covered with an insulating wrapping, and whether or not contained in iron or lead pipes or strengthened with iron or steel cords or wires.

Carbon prepared for electric lights, $5.55 per 100 kilogrammes.

Dynamo-electrical machines: (a) Those weighing more than 50 kilogrammes, $8.148 per 100 kilogrammes, gross weight. (b) Those weighing 50 kilogrammes or less, and the inductors and separate pieces, $13.89 per 100 kilogrames, gross weight.

Gross weight includes all wrappings.

Comment Unnecessary.

[From the Railroad Gazette.]

Some time ago a company, interested in introducing gas engines as motors on street railroads, built a railroad in Dessau which was to demonstrate the advantages of such motors and serve as a model. Now this railroad has contracted with Siemens & Halske for an electric plant.

West End Street Railway Affairs.

[Special correspondence of the Western Electrician.]

Boston, November 23.—The tenth annual meeting of the stockholders of the West End Street Railway company was held in this city to-day. President Samuel Little submitted his annual report, and the following board of directors was elected: Samuel Little, G. T. W. Braman, T. Jefferson Coolidge, William Hooper, Albert C. Houghton, Joseph B. Russell, Richard M. Saltonstall, Samuel Spencer, Walter S. Swan, Stephen M. Weld, Moses Williams, Alfred Winsor.

The report to the stockholders was in substance as follows:

Your directors submit the following statement and report covering the operations of your railway for the year ended September 30, 1897:

Gross earnings	(increase	$377,073.49)	$8,719,031.78
Operating expenses	(decrease	120,910.58)	6,213,708.56
Net earnings	(increase	$497,984.07)	$2,505,323.22
Taxes		$372,460.18	
Interest and rentals of leased roads and subway		507,915.38	
Total fixed charges			880,375.56
Balance			$1,624,947.66
Against which the dividend charges were as follows:			
8 per cent. dividend on preferred stock		$512,000.00	
3¼ per cent dividend on common stock, paid April 1st		317,975.00	
4 per cent. dividend on common stock, to be paid October 1st		363,400.00	1,193,375.00
Balance			$431,572 66
Against which are charged value of tracks taken up, and bad debts, etc., written off, as shown in the auditor's statement C		$449,258.49	
Less credit for transfer of insurance: Sinking fund		79,478.59	369,779.90
Surplus			$ 61,792.76

In his report President Little pays considerable attention to the subway. He says:

"The past fiscal year has been marked by two events in connection with the company of more importance than any that have preceded them—the leasing and opening of the subway and the leasing of the road to the Boston Elevated Railroad company. On December 15, 1896, a contract for a lease of the subway having been signed by the city of Boston and by the Transit Commisison, and by your president, duly authorized by the board of directors, a special meeting of the stockholders was held and the contract was ratified by them. Subsequently the contract was approved by the Board of Railroad Commissioners, and became binding upon your company for 20 years, as provided in the contract.

"The portions of the subway from the Public Garden, and from Tremont street and Pleasant street to Park Street station, were completed during the past season. The completed portions are believed to be constructed in the most permanent and substantial manner. The engineering skill which has been shown in the construction of this—the most extensive work of the kind in the country when it is remembered that for a large part of its route it is under the most congested streets of the city—and the success of the engineers in overcoming the difficult problems which arose in the progress of the work, have been most favorably commented on by engineering experts from this country as well as from many foreign countries, who have professed great pleasure in the examination of the work. When the work upon the now completed portion of the subway had been sufficiently advanced to permit it, the track-laying and equipping of the same was commenced by the company. The directors authorized the engagement of a well-known expert engineer to advise with our own construction and engineering departments and present plans for the work in all its details, with the end in view that the work might be of the most substantial character, the chances of accident eliminated or reduced to the minimum, and, withal, to make it as comfortable and acceptable to our patrons as possible. It is believed that to a great extent this has been accomplished.

"The roadbed consists of an 85-pound T-rail laid on chestnut ties bedded in a bottom of cracked stone about 14 inches in depth. On the entire length of this rail is a firmly attached guard-rail, with a surface above the rail for travel of seven-eighths of an inch, making a total weight of rail of 128 pounds to the yard. This would seem to make the derailment of a car improbable, if not well-nigh impossible. No gas or oil is used in the subway. The lighting is from two entirely separate electric circuits, and the lighting of the cars from still another circuit, making the chances of the subway ever being in darkness very small. A complete system of hydrants connected with the city water has been introduced, with a full attachment of hose always ready for use if occasion should require. The same care and precaution have been taken in all the various details of equipment.

"The portion of the subway from the Public Garden to Park street was opened for travel September 1, 1897; and from Tremont street and Shawmut avenue to Park street October 1, 1897. It is expected that during the coming year the portion from Park street to the Union station will be completed and open for travel.

"The portion of the subway in use at the present

time is open for travel from 6 a. m. to midnight, during each day of the week. There are at present 1,362 trips per day being run through the subway. In the immediate future three additional lines of cars will be added, making a total of 1,790 regular trips per day, with extra trips as the travel demands. This, in the busy hours of the day, when the largest number of trips per hour is being run, will give from two to three cars a minute leaving Park street, which is quite a tax upon the capacity of that station. Our returns show that nearly one-fifth of the passengers taking the cars in the subway during the day do so between the hours of 5 and 6 p. m. and that 90 per cent of these take cars at Park street.

"Our returns show that seven per cent. of the total number of passengers carried over the entire system are carried through the subway.

"The number of total round trips made daily by cars north of Boylston, on Tremont street, to Union station, Charlestown, Chelsea Ferry and Somerville is 1,757.

"The cost to the company of equipping the portion of the subway already in use has been large, and when the remaining portion is completed a large outlay for equipment will be required. The contract for the use of the subway and the cost of the care of same, and the quite considerable force of men employed when the whole shall have been completed, will entail a large expense upon the company. As the charge for rental is based upon the cost, and as it can only be estimated at this time what part of the $7,000,000 authorized will be spent on construction, the charge to the company for rental can only be estimated, but the work has so far proceeded that it can be safely stated that the cost to the company for rental and expenses will be at least $350,000 per annum, and this with no account made of the expense of equipping the subway. With only a portion of the subway open for travel, and that having been in use but a short time, it is too early to expect any judgment of the effect of the subway when completed and in use, upon the travel of the road.

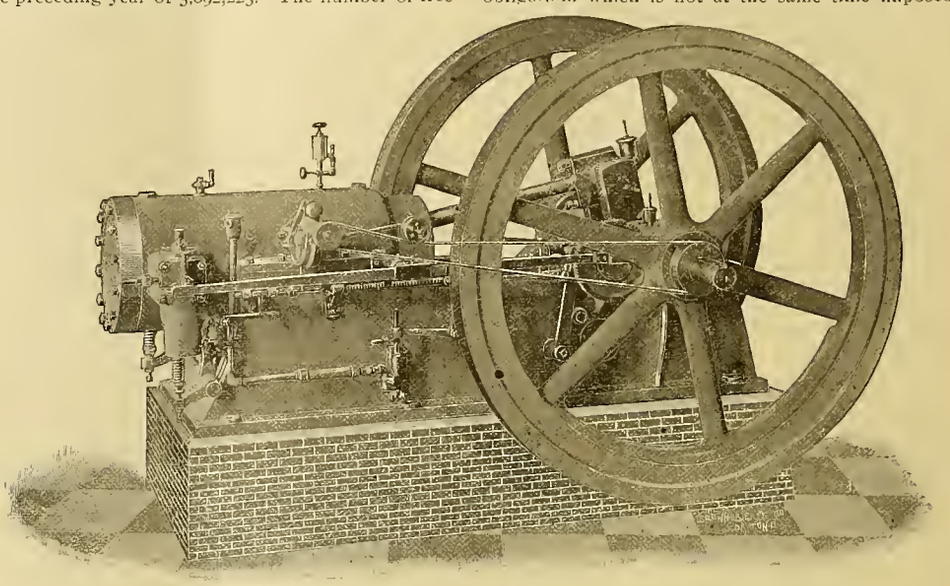
"During the year land has been purchased on Boylston street, Cambridge, near Harvard Square, on the borders of the Charles River, for the erection of a power house, which is at the present time very nearly completed. This house will contain three direct-coupled engines of 1,800 horse power each, making a total of 5,400 horse power. This will make the rated horse power at all stations 30,950. The building which has been erected is a most substantial one, and has capacity for the installing of another engine. The chimney has been completed, of dimensions large enough for nearly double the capacity of the present house. The boilers and machinery, both steam and electrical, with all the appurtenances, are believed to be of the highest grade for efficiency and durability, and it is expected that when this house is completed and put into service it will be a model one in every particular.

"There have been purchased during the year 175 nine-bench open cars. At the date of the annual report, September 30, 1897, the road was under contract for 60 25-foot box cars, which have since that date been received, but are not included in the report. Maintenance and repairs of track are a large item in the expenses of the company. There has been expended during the year for this purpose $831,411.51. There has been used on new construction and on repairs of track 5,984 15/20 tons of rails. There has been expended for girder special work $116,372; for tram cast special work, $13,447. These items do not include the cost of laying the same.

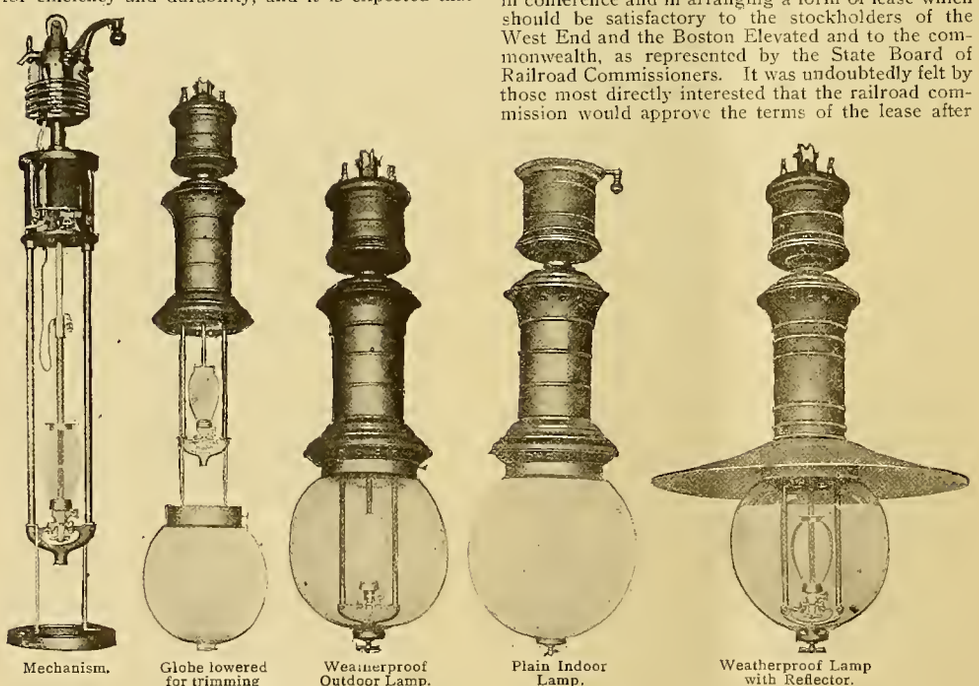
"On September 30th the company had underground conduits laid with a length of 9.15 miles, containing 120.32 miles of duct, 47.02 miles of feeder cable, 2.78 miles of telephone cable, 18.43 miles return cable with duct, and of buried return cables other than in duct, 35.67 miles. Quite a percentage of this was in sections outside of the prescribed district for laying underground cables.

"The passenger car mileage for the year has been 29,786,936 miles, an increase over the previous year of 3,945,029 miles. The number of revenue passengers carried has been 172,554,513, an increase over the preceding year of 5,692,225. The number of free transfer passengers carried during the year has been 23,777,726, an increase over the previous year of 6,211,365. This makes the total number of passengers carried in the cars 196,332,239.

"The number of employes in all departments is 5,095."



GAS AND GASOLINE ENGINES.



Mechanism. Globe lowered for trimming and cleaning. Weatherproof Outdoor Lamp. Plain Indoor Lamp. Weatherproof Lamp with Reflector.

DIEHL IMPROVED EECLOSED ARC LAMPS.

The Board of Railroad Commissioners has refused to ratify the terms of the lease of the West End street railroad to the Boston Elevated Railroad company. Without the approval of this board the lease cannot become valid. Months were spent after the Elevated Railroad act had passed the Legislature last spring by representatives of the two companies in conference and in arranging a form of lease which should be satisfactory to the stockholders of the West End and the Boston Elevated and to the commonwealth, as represented by the State Board of Railroad Commissioners. It was undoubtedly felt by those most directly interested that the railroad commission would approve the terms of the lease after giving the matter a reasonable amount of thought and consideration, and it was something of a surprise when, two months ago, the commission appointed a board of three experts, one of whom was a real estate broker, the second a civil engineer and the third a practical street railroad man, to make an appraisal of the property and equipments of the West End, declining to give its decision on the lease until the report from these experts had been received. This has been made, and while the details of the report are not given to the public, the railroad commissioners state in the document which gives their reasons for refusing to ratify the terms of the lease that the recent investigation made into the valuation of the West End showed that apparently the road had been applying too little of its assets to the depreciation of property, and that in consequence there is a deficit of more than eight per cent., which would make the dividend on the intrinsic value of the stock still higher.

Two principal reasons are given by the railroad commissioners for refusing to approve the terms of the lease. The first of these is that the lease, as drawn, takes the West End out of the special class of railways that may be controlled at any time by specific legislation and places it under the charter of the Boston Elevated Railroad company, which specially provides that no "other burden, duty or obligation, which is not at the same time imposed by general laws on all street railway companies" shall be placed upon it. This, in the opinion of the commissioners, removes a valuable safeguard to public safety and convenience in the conduct of the road by making it necessary to apply to every road in the state any measure needed to correct local abuses of any kind.

The second important defect with the lease, as it affects public interests, is that from the long term, 99 years, it would exercise an important influence toward blocking any reforms in the reduction of existing fares because of the large compensation to be paid to the West End, which would, in the opinion of the commissioners, tax the earning power of the new company to the utmost. The Elevated company agrees to pay eight per cent. on the stock of the West End, besides other charges and expenses that would bring the total up to 11 per cent. on the par value of the common stock, which is absolutely guaranteed, whether earned or not. In the last four years and three-quarters the West End has earned 6.84 per cent. on its common stock, and there is no reason to suppose that in the future it would earn more, the tendency, in fact, being toward a decrease rather than an increase in the value of investments. On the contrary, the West End might easily be placed in a position where its earnings would materially fall off, in spite of which this large dividend is absolutely guaranteed by the provisions of the lease for a term covering three generations. The commissioners point out that, in the lease of the subway and the charter of the Elevated road the Legislature has carefully followed its usual policy of giving concession for only a comparatively short term, and that this lease should be drawn in accordance with the same policy. In connection with this the report says: "The proposed lease in its present form is wholly discordant with the public policy deliberately settled and wisely restricted by the Legislature. It is practically destructive to that policy." As this large rental must be deducted from the net earnings of the Elevated company before there could be any possibility of any reduction in fares, it becomes evident that this provision works directly against any such reduction.

The news of the decision of the railroad commissioners was received on the stock exchange this morning and had a most emphatic effect. Yesterday the final sale of the common stock was at 94¾; in the first hour of trading this morning the price ran off to 86¾ on dealings which aggregated some 6,000 shares. This was in one hour only; after 11 a. m. the decline continued, carrying the price to 85¼. The preferred stock sold in a small way only, at 100½, a decline of but 1. In the middle of the afternoon fresh selling on exhausted margins carried the price to 81, a total drop of 13¾. The West End shares have a par value of $50. There are 181,700 common shares, and the drop of $13.75 per share shows a decrease in the market on selling value of the equity of the property, of $2,498,375. This may be taken as the first effort of the "street" to appraise the presumable damage to the stock of the company by the decision of the railroad commissioners.

The decision of the railroad commissioners will undoubtedly meets general approval. It again disproves the assertion that the railroad commissioners, as a board, are committed to the interests of corporations.

Weston Imperial Engines for Dynamo Driving.

The illustrations show the Weston Engine company's Imperial engine directly connected to dynamos—in one case to a Triumph generator and in the other to a C & C machine. The company builds belted engines of all sizes, but has also a full line of patterns for all the prominent dynamos now on the market and can promptly deliver engines for direct connection in sizes up to 250 horse power. The pictures show the general appearance of the engine and the compactness of direct-connected units.

The Imperial engine is of the center crank, automatic type, and is built for high and medium speeds. It is self-oiling, without the use of oil-cups, pumps or tanks, every bearing being automatically supplied with oil from reservoirs within the engine. By the peculiar construction of the main bearings, there is no possibility of oil being thrown on the dynamo. The engine is dust-proof, and the company guarantees it to be of longer life and to require less attention than engines of other makes. All engines are tested at the works under a working pressure of 125 pounds and are subjected to a continuous run of at least five hours under full load.

The valve is a single casting with parallel faces and works steam-tight between its seat and a heavy pressure plate. The steam, being admitted to the outside of the valve, acts in a direction to force the pressure plate against the valve. This it is prevented from doing by distance pieces, top and bottom, that rest against the valve seat. Thus the entire pressure of steam is carried by the pressure plate, and the valve is left to work in perfect balance, even under the most extreme steam pressure. By recessing the pressure plate to correspond with the ports of cylinder, four openings are obtained for the admission of steam, each equaling in length the diameter of the cylinder. This, together with a large travel and ample ports, gives, it is stated, a high steam line and a sharp cut-off. The exhaust is through a double opening, and is attended with the same advantages that characterize the steam admission. This form of valve, when properly fitted up, will keep tight for long time, acquiring a beautiful polish and working without appreciable friction.

A distinctive feature of the engine is the method of attaching the counterbalancing disks to the crank-shaft. This is effected by flanges attached to the sides of the crank cheeks, which are drilled for the studs fastened in the counterbalancing disks. By leaving a collar on the shaft next to the cheeks and a hole in the disks to correspond to this collar, the disks may be slipped over the shaft easily and replaced accurately in the true position.

Rites' inertia governor is used in a late adaptation. The entire governor consists of a single moving piece swinging on a single supporting pin, and even the eccentric is integrally formed with the weight structure. With no link whatever and no interlocking scheme, with no dash-pot or obstructing mechanism in connection with the governor, it is thought that the limit of simplicity has been reached, while it is said that a performance not before dreamed of as a possibility is reached with ease. The centrifugal element is combined in the same piece with an inertia element relatively so great that instantaneous and extreme changes of load are provided for coincident with such variation, without waiting for the otherwise necessary manifestation of centrifugal force. The crowning feature is the resistance of the exaggerated inertia to the disturbing action of gravity, whereby the balancing weight is dispensed with and the whole governor is reduced to a single piece.

High Potential Pin.

The call for a heavy pin, designed especially to carry heavy cables and in every way perfectly insulate them, has been met by the invention of Fred M. Locke of Victor, N. Y., shown in the accompanying illustration. The total length of pin is 10 inches, having a one-half inch bolt running through a wood top five inches long, which is made of selected oak thoroughly dried and then saturated with paraffine. As a base to this top there is a porcelain insulator three inches and a half long. This device has been adopted by the Southern California Power company of Redlands, Cal., which operates the longest street railway line in America, and also carries the highest pressure, 33,000 volts. It is claimed for this device that it will safely carry 50,000 volts.

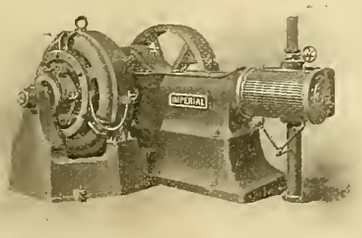
Diehl Improved Enclosed Arc Lamp.

The use of enclosed arc, or long burning, lamps in modern electric lighting practice has become so general and the advantages of this class of lamps are so thoroughly understood that it is needless to mention their merits. The latest type of this lamp to be placed on the market by the Diehl Manufacturing company of Elizabethport, N. J., is herewith illustrated.

The cuts show the general design of the lamp for indoor and outdoor use and the method of lowering the outer globe and holding it in position while the lamp is being trimmed. The lower carbon holder, to which the inner globe is rigidly clamped by a spinning, is securely held in a socket on the frame of the lamp, but it may be instantly detached, bringing with it the inner globe and lower carbon. This makes it the easiest and quickest lamp to trim, reducing the breakage of inner globes to a minimum and admitting of perfect alignment of the carbons.

The outer globe-holder screws into the bottom frame of the lamp, and not only forms a rigid support for the globe, but permits standing the lamp on end during installation or at any time when it may be necessary to take it down.

The mechanism is extremely simple. There are no gear wheels, pinions or springs. The magnets are firmly held at both ends and two large dash-pots maintain a steady arc without flickering or jumping. The clutch is a particularly firm yet sensitive one and gives to the lamp an almost imperceptible feed. There are no sliding contacts on the



WESTON IMPERIAL ENGINES FOR DYNAMO DRIVING.

rack rod, the current being supplied to the upper carbon by a flexible cable.

It is impossible for a carbon to become jammed in the lower holder, as it is so designed that by loosening one binding screw the jaws may be entirely removed from the holder. This point will be found of the greatest convenience.

In case of breakage of an inner globe or bulb a new globe may be inserted in the spinning already on the lamp, as the bulb is retained in the spinning by a binding coil. This obviates the purchase of a new spinning with every globe, and when screwed down upon the lower carbon holder it forms an absolutely air-tight joint.

The ornamental lamps are furnished in a number of special finishes, the ones most in demand being bronze, ebony, iridescent, oxidized copper, oxidized brass, dull brass with black bands, antique copper and gold lacquer, the latter giving an especially rich effect. The plain indoor lamps are furnished in lustrous black, but may be had in a dull black finish instead if so desired. All indoor lamps, whether ornamental or plain, are equipped with switch for turning the current on and off.

Gas and Gasoline Engines.

Among the progressive manufacturers of gas and gasoline engines the Foos Gas Engine company of Springfield, Ohio, whose engine is represented in the accompanying cut, occupies a prominent position, as pioneer gas engine builder in the West. It is claimed for the Foos engine that it combines simplicity, excellent finish and durability, with efficiency, economy and safety. The principle of construction is based on the well-known four-cycle system, namely, drawing in a charge of air and gas or gasoline during the first forward stroke of the piston, compressing this mixture on the return stroke, at the end of which it is fired by an electric spark generated by the battery furnished with each engine. During the second forward or working stroke the expansion of the exploded mixture takes place, and on the fourth stroke of the piston, which completes the cycle, the products of combustion are expelled through the exhaust valve. Both inlet and exhaust valves are operated positively by cams and levers, and the inner surface of the cylinder, over which the piston travels, is free from any ports or holes, as used in some engines for the purpose of exhausting the burnt gases.

Among the special features of the Foos engine is the ingeniously constructed electric igniter. It accomplishes the object of always producing a bright spark by using what is known as the "wiping contact," which assures absolutely clean surfaces of the two electrodes, the wiping action in itself having the effect of removing any oil or other unclean substances from the points of contact.

The extreme sensitiveness of the governor makes it especially well adapted for all purposes requiring absolute steadiness of speed, such as generating electric current for light and power use, flour mills and similar plants.

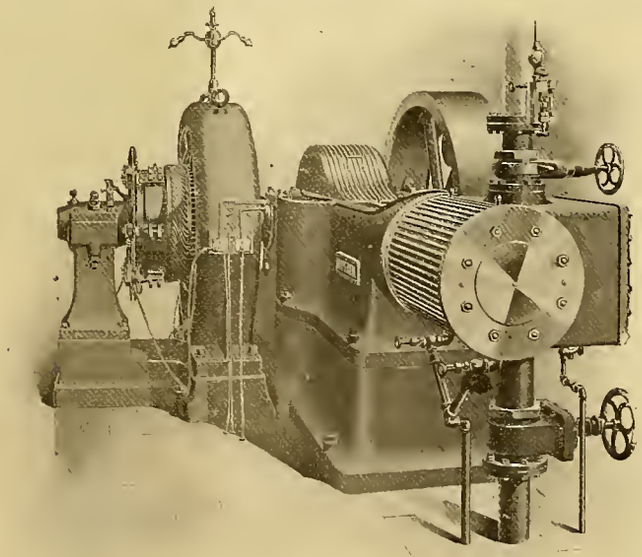
For electrical work of every description, including the driving of arc and incandescent light dynamos, power generators for street railway and similar purposes and electro-plating dynamos, the Foos gas and gasoline engine is forging to the front as a most reliable, economical and efficient engine.

During recent years a number of electric plants have been installed in which the Foos engine furnishes power. Special electric light engines, fitted with a most sensitive governor and flywheels of sufficient size and weight to insure a perfectly steady incandescent light, are being installed constantly in hotels, office buildings and manufacturing establishments for operating isolated light plants. Central stations for towns of moderate size are also supplied with gas or gasoline motors, the plants being in most cases so arranged as to enable the operator to either drive pumps for supplying water to reservoirs or to connect the engines to the dynamos. In this manner a neat combination of electric light and water works can be erected at a very small outlay.

Export Trade in Heavy Machinery.

From a recent newspaper interview with William W. Allis, president of the Edward P. Allis company of Milwaukee, the following interesting statements are taken:

"We are just now making machinery for the underground railway in London. Besides this we are filling orders for engines for the electric railways or tramways in Edinburg, Scotland; Dublin, Ireland; Madrid and Barcelona, Spain, and Sydney, Australia. They have come to recognize in England and elsewhere that we are far advanced in the making of machinery and they come to us to get it. To-day we received a visit from a special representative of the South African Consolidated Gold Fields, who has placed with us an order for more machinery. That concern is, perhaps, the wealthiest and most successful gold concern in the world, whose stock, now worth some $500,000,000, has advanced 1,000 per cent. since the company was first founded. The mines are located in the same field where the late Barney Barnato made his fortune. We have furnished them so far about $1,000,000 of machinery, and are to furnish them a great deal more. At Edinburg, Dublin, Madrid and Barcelona, where we are furnishing tramway power machinery, the contracts amount to about $500,000 in each. Our contract for equipping the tramway at Sydney is with the Australian government, and amounts to considerably more. Aside from this we have recently secured a contract for supplying blowing machinery for steel works at Trieste, Austria, without even any competition. The representatives of those works have inspected the Carnegie works at Pittsburg and seen the blowing engines which we have made and which are in use there. The impression produced on them by what they saw was such that



WESTON IMPERIAL ENGINES FOR DYNAMO DRIVING.

HIGH POTENTIAL PIN.

they came here and left an order for the same kind of engines. Twelve of such engines, made by us for Carnegie, have caused the shutting off of 40 boilers at one of Carnegie's plants, and this furnishes an idea of the great saving in steam and coal. We are very busy and have all we can do to fill orders."

The Allis works have for some time been running day and night, and the force of men employed has been nearly doubled in the last few months.

New Telegraph Key.

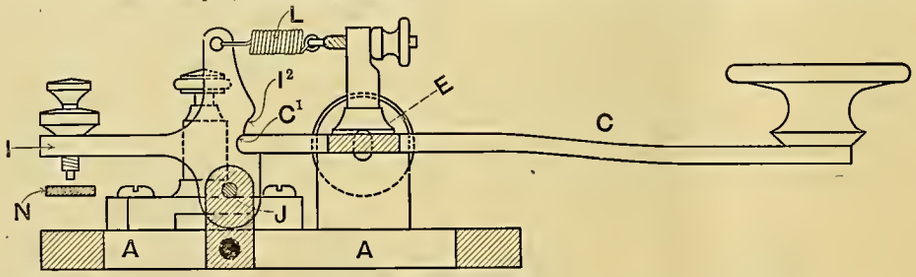
E. W. Farnham of the Chicago, Burlington and Quincy Railroad company, who is a practical telegrapher, has for some time been at work on the problem of improving the telegraph key, primarily with the end in view of preventing that scourge of operators, known as telegraphers' paralysis, and secondly, in a desire to simplify the work of the operator.

The inducing cause of telegraphers' cramp, or paralysis, is the constant solid concussion between the key and the anvil, continued for hours, which ultimately affects the nerves of the hand and wrist. It requires 77 of these blows to go once through the Morse alphabet, omitting the figures and other marks.

Mr. Farnham has made the blow on the anvil a yielding one, thus destroying the shock. This is accomplished through a secondary lever, moved by the ordinary key, the opening spring being attached to the secondary, which is of a T-shape. The principle of increasing motion by increased leverage is taken advantage of, so that a very minute and particularly easy motion of the hand does the work, while the contact between the key and the anvil is silent and yielding, the latter being a spring. The contact is one, too, which is far less liable to fouling and making an imperfect signal because of the slightly sliding contact motion.

The circuit closer is also done away with in Mr. Farnham's key. The contact between the key lever and the secondary lever is of such a nature as to require but a slightly extra pressure to close the key permanently, and in this position it is far less liable to accidental opening through handling books, blanks, etc., on the operator's table.

The illustration herewith should make the features clear. A, the base of the key, is quite similar to the ordinary base. The key lever C is movable on the trunnions E, but ends at C, where it makes a mechanical contact with the secondary lever I, which is somewhat T-shaped, centered at the lower



NEW TELEGRAPH KEY.

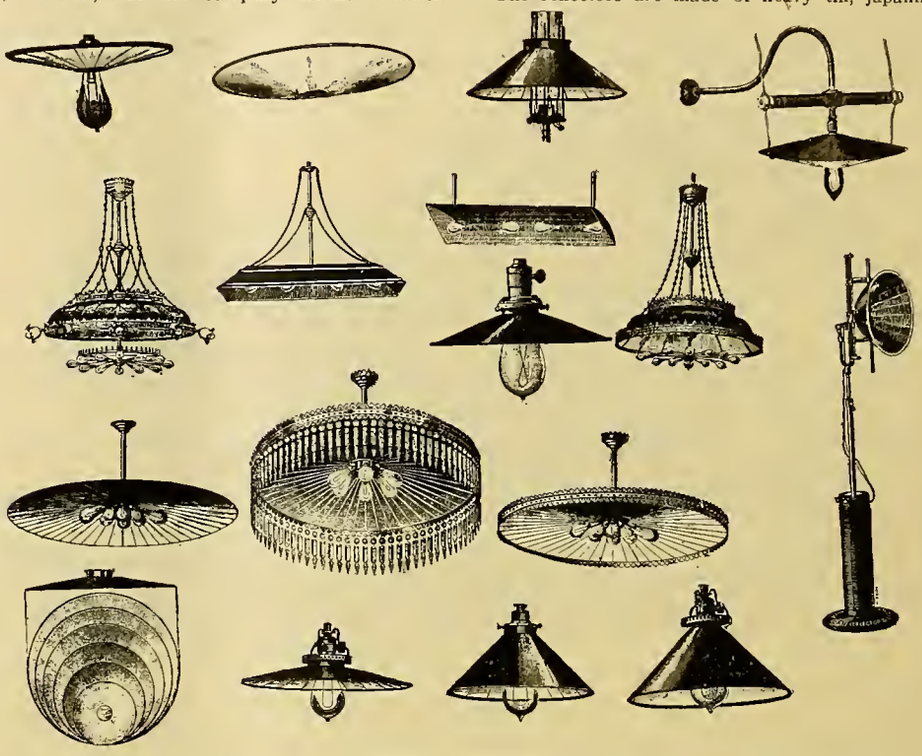
extremity, at J, while the upper part has an adjustable spring L. The third portion of the lever carries the contact point directly over the spring anvil N.

A depression of the key acts upon the secondary lever through the lower of two contact notches, or hollows in the secondary lever, closing it at N, and on opening the key the spring L acts to open the contact at N. Above this lower notch is seen another, I², into which, by a slightly increased pressure on the key the end at C is forced, which depresses N still further than in the writing contact, and locks the key firmly. To use the key anew requires but a slight lifting pressure, while an accidental opening is almost impossible.

Fred Brush contemplates putting in an electric light plant for Warren, Minn.

American Reflectors.

The accompanying cut indicates the character and variety of the electrical reflector goods manufactured by the American Reflector and Lighting company, 271-273 Franklin street, Chicago. It is only fair to say, however, that the company makes a much greater variety than is here shown, and it is prepared to produce special designs.



AMERICAN REFLECTORS.

The "Paragon" reflectors, as a special line of the American company's product is called, are adapted to general uses, utilizing, the company claims, all the light possible, and distributing it where it is wanted. They are made in a great variety of forms, depending upon the position in which they are to be used; also upon area and shape of space to be lighted, the object being to have each reflector give the best possible results, all things considered. The increased efficiency of light due to the reflectors, as demonstrated by scientific experiments, varies from 300 to 400 per cent., the average increase with reflectors being over four times that without reflectors.

The system consists of entirely new and improved forms, made up by combinations of the surfaces generated by the revolutions of one or more of the conic sections.

The combination of these surfaces about a common focus, which is the center of the light used, with such arrangement as will produce a uniform intensity of the light over the area to be lighted, and also to intercept the rays which usually go upward and off into space with no practical efficiency and throw them with the remainder into the space desired, thus utilizing all the light possible, is what is accomplished by these reflectors.

The reflectors are made of heavy tin, japanned dark green, are very strong and rigid, yet of neat and graceful appearance. They are lined with imported crystal glass, which is plated with pure metallic silver, well protected by a coating, rendering it impervious to moisture, gases or other injurious influences. The crystal glass gives the best practical reflecting surface known; it is also the most durable and easily cared for. The American Reflector company manufactures over 150 styles of reflectors for electricity, gas and oil, and it is making a specialty of all styles of reflectors for users of electric light under almost every condition. It makes reflectors for lighting art galleries, window reflectors, orchestra shades, incandescent street electric light hoods, stage dimmers, incandescent calcium light theatrical lamps with hand feed; also reflector chandeliers, hall and vestibule lamps, silver-plated mirror reflectors for incandescent clusters with prisms. It will materially assist one in gaining some idea of the full extent of the line of reflector goods carried by this institution to procure one of its complete catalogues, which will be sent on request.

Improved Robertson-Thompson Indicator.

The improved Robertson-Thompson indicator, which has just been placed on the market, is unusually heavy, but as a result of most careful experiment this weight is so perfectly distributed that the best results may be attained at speeds far in excess of any met with in actual practice. One of the most serious errors in ordinary indicator work is caused by flexure of the arm which carries the drum, particularly when the cord is carried above or below the instrument. In this manner an error of 10 per cent. is easily possible, particularly if the instrument is being used with a high-pressure spring. For instance, with an 80 spring, it would require a movement of but one-eightieth of an inch to show an error of one pound. In many cases weakness at this point will account for the curious features often noticed at the junction of the admission and steam lines on the diagram. The drum-carrying arm of the improved Robertson-Thompson indicator is so stiff that no error from this cause is possible.

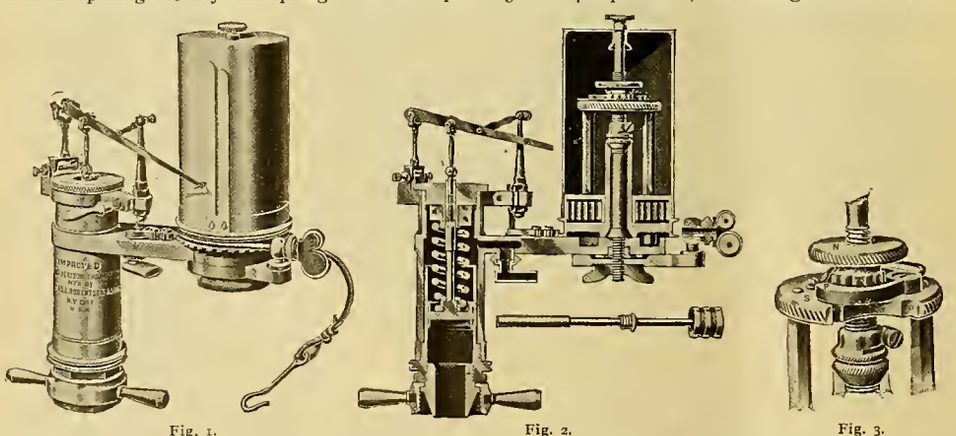


Fig. 1. Fig. 2. Fig. 3.

IMPROVED ROBERTSON-THOMPSON INDICATOR.

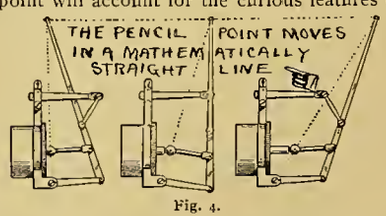


Fig. 4.

The cylinder is steam jacketed, and by its construction the possibility of the piston being cramped as a result of external strains is precluded. The area of this cylinder is exactly one-half inch, and each spring is suitable for twice the pressure stamped on it; for instance, a 60 spring may be used for a pres-

sure of 120 pounds or less. The coupling is reamed to one-quarter inch area, and with each instrument an extra one-quarter inch piston is furnished, as shown in Fig. 2. With this piston each spring may be used for pressures four times as great as the number stamped thereon, so that with a 60 spring 240 pounds may be safely indicated. This extra piston is of special value for hydraulic and gas engine work. The pistons are made of steel, but phosphor-bronze will be substituted if preferred. The piston springs are standardized by the most approved testing apparatus, in connection with a mercury column. To guarantee against pressure above the piston a large relief opening has been provided, the outlet being a neat swivel elbow by means of which the "blow" may be discharged in any direction, at the will of the operator. Each instrument is provided with a detent or stop motion.

In Fig. 3 a new device is shown for adjusting the tension of the drum spring. By rotating the knurled head S to the right, the spring may be tightened as much as desired and securely held by pawl P; the ratchet wheel N is securely attached to the shaft by means of a left-hand thread. Thus the tendency of the drum spring is to tighten this ratchet nut more firmly. By pressing the thumb into the recess in the spring winder S the pawl is released, when the tension may be diminished to any desired amount. This ratchet wheel has 16 teeth, which provide for the adjustment of the spring to a nicety. Drum springs are of the clock type, but spiral form will be furnished if preferred. Cone bearings are provided to take up all wear of the drum spindle. The parallel movement is made of tool steel, highly polished and richly blued. All bearings are wide and perfectly fitted.

In Fig. 4 the pencil mechanism is shown in three positions, which will give a perfect idea of the manner in which an absolutely correct straight line is obtained. This movement forms a perfect pantograph, so that the pencil movement is exactly proportional to that of the piston, the ratio being five to one.

All moving parts are worked down to the lightest weight consistent with durability. For comparison it may be stated that the drum weight is but 1¼ ounces, and the pencil lever 25 grains.

By special order the instrument will be fitted with the improved Victor reducing wheel, which comprises the usual cord-feeding device. The manufacturers are James L. Robertson & Sons, No. 204 Fulton street, New York.

American Society of Civil Engineers.

The new home of the American Society of Civil Engineers at No. 220 West Fifty-second street, New York, has been formally opened. It covers a plot of ground 50 feet wide and 110 feet deep. The exterior walls are faced with Indiana limestone, and the building is handsome and dignified in appearance. It was designed by C. L. W. Eidlitz. On the first floor are the reception room, coat room and the offices of the secretary, as well as a large room intended for a convenient meeting place for members for social as well as business intercourse. On the second floor are the reading room and auditorium, the latter having a seating capacity of over 400. On the third floor space is reserved for a museum and model room; the clerical force has offices here. The fourth floor is used exclusively as a stack room, where the books have a permanent place. An electric hoist for books runs to the reading room on the second floor. The stack room has a total capacity of over 100,000 volumes and the stacks for books are similar to those used in the new Congressional Library at Washington. In the basement are janitor's quarters, with storage and publication rooms. The building is steam-heated throughout and lighted by electricity, the energy for which is provided by two gas engines of 25 horse power each. This society is purely a scientific body and the building is in no sense a clubhouse, its use being entirely for the advancement of the science of engineering. It is the first building erected in America to be devoted to that exclusive purpose.

The society was founded 45 years ago and has now 2,100 members, with an annual income of over $40,000. Thirty-eight volumes of its transactions have been issued, and its library numbers 22,000 volumes. Its membership embraces many eminent names.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the Western Electrician.]

The Wisconsin Valley Telephone company will extend its line from Black River Falls, Wis., to Viroqua, Wis., at once.

Edwin C. Sparks has taken charge of the Stevens Point, Wis., telephone exchange, succeeding B. B. Flack.

The Inland Telephone and Telegraph company contemplates an extension of 300 miles to connect with Boise, Idaho, and La Grande and Baker City, Oregon.

The Wisconsin Telephone company is constructing a line from Hurley, Wis., to Iron Belt.

A co-operative telephone company has been formed at Yucatan, Minn., to build a line to Houston, Minn.

John Avery, manager of the Merrill, Wis., office of the Wisconsin Telephone company, has been transferred to Grand Rapids, Wis. A. W. Rumsey, who has been at Grand Rapids, has been making a determined fight against the local company, but it proved a losing one.

The Mutual Telephone company of Des Moines, Ia., has arranged for toll-line connection with about 200 towns in Iowa and Missouri.

The Ottumwa Telephone company has begun construction work for its exchange at Ottumwa, Ia.

Arrangements have been made and a company formed at Fond du Lac, Wis., to build a telephone line to Calumetville, Wis., work to be begun in the spring.

W. S. Crowley has applied for a franchise for a local telephone exchange in St. James, Minn.

The Wisconsin Valley Telephone company has awarded the contract to construct a line from Ashland to Hayward, Wis., to J. J. McGeehan of Ashland, and for a line from Ashland to Superior to P. J. Raarup. A loop of 40 miles will be made to take in Port Wing, Orienta and the mouth of the Brule, on the Ashland-Superior line. A line to Hurley and Ironwood will be built in the spring.

The Dell Rapids, S. D., Telephone company has been incorporated to put in a local exchange. It will start with 26 instruments.

C. J. Smallwood is taking steps to put in an exchange at Worthington, Minn., if enough business can be secured.

The Wisconsin Telephone company announces a reduction in rates at Ashland, Wis.

A telephone exchange may be installed in Church's Ferry, N. D.

Sioux City, Ia., and Sioux Falls, S. D., are now connected by telephone. This enables patrons in Minneapolis to talk with persons in Sioux City.

Nearly all the stations on the Minneapolis-Willmar lines are equipped for service.

P. G. Reynolds, superintendent of construction for the Northwestern Telephone company, has returned from Waco, Tex.

Three-cent Fare Argument.

The question of the jurisdiction of the United States Court of Appeals in the Indianapolis three-cent street-car fare case was argued recently before Judges Woods, Jenkins and Bunn of that court in Chicago. W. H. H. Miller represented the street-car interests and City Attorney John W. Kern appeared for the city of Indianapolis.

The attorneys argued on a motion to dismiss the appeal of the city from the temporary injunction issued by Judge Showalter. Mr. Miller's clients contend that the question is one affecting the construction of the federal constitution, and that the right to construe constitutional questions is with the United States Supreme Court. He claimed that the appeal should have been taken to that tribunal. On the other hand Attorney Kern asserts that Judge Showalter's injunction is in the nature of an interlocutory decree, and that the act creating the Circuit Court of Appeals specifically reserves the right to pass upon such decrees to the Court of Appeals. He contends that the involving of a constitutional question in no wise weakens the present appeal.

The main case is one in which the Central Trust company of New York in a bill filed in the Federal Court at Indianapolis asked for an injunction restraining the enforcement of the three-cent car-fare act pased by the Legislature of Indiana last March. The Trust company is the mortgagee for a $3,000,000 bond issue of the Indianapolis street-car lines, and claims that the three-cent fare will irremediably injure the value of the securities, and is in contravention of the constitution of the United States, which declares that no states shall pass any law "impairing the obligation of contracts."

The Trust company also asserted that the act of the Legislature was class legislation, as it restricted the three-cent fare to Indianapolis alone.

In the argument before Judge Showalter the city claimed that the Supreme Court of Indiana alone was competent to pass upon the constitutionality of the law, and that the Federal Court should not make any order until the state Supreme Court had passed upon the question.

Judge Showalter, in granting the temporary injunction, held that a federal question was involved, and that, further, the citizenship of the trust company gave it a right in the Federal Court. On that phase he said: "When a federal question is involved the decision of the highest court of the state is not final, but is reviewable by the Supreme Court of the United States. To this extent at least the judicial power of the state is subordinate to that of the United States." He held that it would be unjust to refuse protection to the street car company until after the state Supreme Court had passed upon the validity of the act; that the company should not be compelled to suffer during the pendency of the validity of the act or its contravention of the national constitution.

Referring to the act passed by the Legislature, Judge Showalter termed it "class legislation." It was limited in its operation to cities of 100,000 population by the federal census of 1890. "The legislative intent is made clear," said the court, "and undoubtedly the act was designed never to have any effect or operation anywhere in the state outside of the city of Indianapolis, while it purports to be a general act."

The United States Court of Appeals took the matter under advisement, but will probably not hand down an opinion before January.

CORRESPONDENCE.

New York Notes.

New York, November 30.—In spite of the intensity of feeling that prevails against the Bell interests in this locality, it is not deemed probable that any serious attempt will be made to establish a rival telephone system in Greater New York. The project exploited in the daily papers this week would be generally welcomed, but the conditions do not admit of serious consideration of the plans outlined by the promoters of the enterprise. To begin with, it is claimed, all of the wires are underground below Canal street in New York, and a large portion in Brooklyn is also underground, and the New York Telephone company has entire control of this business. It operates a radius of 33 miles from the city hall to Westchester county, Long Island and Staten Island, and the northern half of New Jersey from Trenton. It uses only the metallic circuit. The New York and New Jersey Telephone company is a sub-company. The New York Telephone company has about 21,000 subscribers on Manhattan Island, and close to 18,000 in Brooklyn and vicinity, after years of hard and persistent work. It is not likely, therefore, that the independent company has 50,000 subscribers, as announced.

John S. Kennedy has secured a temporary injunction in the Supreme Court against the New York Telephone company, restraining that corporation from unlawfully entering his premises or placing hooks and staples on his walls or extending wires over his house. The telephone company is beginning to put a system of aerial cables and wires over private property. Last summer, before beginning the work, the company set out to get permits from the property owners affected to run wires along the boundary walls and fences. It secured the permits of all, it is said, except Mr. Kennedy and Frederic Cromwell, who gave a verbal permit on condition that Mr. Kennedy's consent was secured. Mr. Kennedy was unwilling to permit the driving of hooks and staples and the stringing of wires, and when his consent was sought again it was again refused. Then the New York Telephone company took the matter into its own hands and decided to string the wires whether Mr. Kennedy liked it or not, and he brought this suit to stop the work. On several occasions Mr. Kennedy's servants have driven away employes of the telephone company, who have scaled the fences in their effort to affix staples or hooks for wires. He has had to have his premises almost constantly watched, and at times has himself been on guard in his library.

Following is a statement of the earnings of the Brooklyn Rapid Transit company for the year ended October 31st, compared with the previous year:

	1897.	1896.
Gross earnings	$5,356,105 70	$5,217,620.08
Operating expenses	3,379,046.60	3,431,185 05
Net earnings	$1,977,059.10	$1,786,435.03
Other income	182,342 62	192,314.11
Total net income	$2,159,401 72	$1,978,749.14
Fixed charges	2,069 872.61	2,057,502.68
Surplus	$89,529.11	.....
Deficit	.....	$78,753.54

This is the first time in the history of the corporation that it has been able to make such a favorable showing. The Brooklyn Rapid Transit company embraces the Brooklyn Heights Railroad company and the Brooklyn, Queens County and Suburban Railroad company. Under the management of President Clinton L. Rossiter the Brooklyn Heights company had made a surplus before, but the Suburban had not. The Rapid Transit company had a surplus this year of $89,529.11, as against $78,753.54 deficit last year. The changes in management and methods have resulted in not only putting the company upon a paying basis, but disarming public criticism.

Brooklyn street railway men are so confident that the decision of Justice Andrews, stopping all work on the trolley loop at the New York bridge terminal, will be upset by the Appellate Division, that they have decided to go ahead with the other construction changes on the bridge, notwithstanding the injunction. The presidents of the several roads met at the office of the Brooklyn Heights company, and unanimously resolved to proceed with the other work unaffected by the injunction. James C. Bergen, the counsel for the bridge trustees, it was stated, had made arrangements with the opposing counsel that the appeal motion should be made on December 10th.

President Albert L. Johnson of the Nassau company said:

> With cars operating on the bridge the people crossing would easily reach the 200,000 per day mark, and every day that the the cars are stopped it means just so many more thousands of dollars the public is required to spend. Under through transit the bridge fare will be abolished and passengers will be carried to New York for a five-cent fare, with the added convenience of not being obliged to change cars. Five cents per day saving to 200,000 passengers means a total saving of $10,000, or with 300 working days per year, a total saving per year of $3,000,000 with through transit.

President Rossiter of the Heights road said:

> We shall continue with the work of laying tracks on the bridge because we believe the Appellate Division will quash the injunction. All our arrangements have been made in good faith, and they are for the advantage and benefit of the people who live here now and who will come hereafter to make their

bome in Brooklyn. At present the foot traffic is insignificant, and it will be less when our cars cross the bridge. There will be no danger whatever at the loops. All the railroad presidents are agreed that we should go ahead, and that's what we are going to do. If the present plans are rejected by the courts others will be prepared. We shall cross the bridge.

The Commercial Cable and Telegraph company, capitalized at $100,000, was incorporated at Albany, November 29th. The principal office of the company is in New York, and it proposes to operate a telegraph system throughout the United States and Canada. Its directors are John W. Mackay of Virginia City, Nev.; Dumont Clarke of Schraalenburg, N. J.; James W. Ellsworth of Chicago; Edward C. Bradley of East Orange, N. J.; Charles R. Hosmer and William C. Van Horne of Montreal; Albert B. Chandler, William H. Baker and Edward C. Platt of Brooklyn; Clarence H. Mackay, George G. Ward, George Clapperton and Charles E. Merritt of New York. Officials of the Commercial Cable company and the Postal Telegraph company, which have recently been practically amalgamated, said last night they thought it probable that the incorporation of the new concern meant that the business of the two companies would be conducted in future under the name of the Commercial Cable and Telegraph company. The directors of the new company are largely made up of the men controlling the Commercial and Postal systems.

Washington, D. C.

Washington, November 30.—Telephone communication is about to be arranged between the capitol and the new library building. In addition to the line to the capitol, the library, will also be fitted with a complete system within the building, similar to the systems in use in many of the departments.

It is the policy of the War Department to have all military posts in telegraphic or telephonic communication with the commercial systems, in order to insure the prompt presence of troops at commercial centers in cases of emergency. Plans are accordingly being considered for the construction of a military line between Washington and Fort Washington, Md., and Sheridan Point, Va. The ordnance, engineer and signal departments of the army are particularly interested in securing this communication, and a strong effort will be made to secure an appropriation therefor from the coming Congress.

A complete system of electric lighting is being placed in the buildings and grounds at the Soldiers' Home. The plan of establishing a plant was proposed several months ago and was recommended to the board of managers by the governor of the home. The wires have been erected under the direct supervision of the officers of the home. On 75 of the poles clusters each containing four incandescent lamps have been placed. The illumination will render the grounds much safer on dark evenings, and will be appreciated by all who frequent the grounds. About 2,000 lights are being placed in the home buildings. The dynamos and engines will be located in a building which is being erected immediately adjoining the engine house.

There are 273 buildings throughout the country under the control of the Treasury Department, and in the larger cities the buildings are equipped with electric light plants belonging to the government and operated by it. The plant in the new post-office in this city will comprise four vertical cross or horizontal tandem compound self-contained engines, which must each have a guaranteed duty with 125 pounds initial pressure. Each engine is to be connected to a 120-kilowatt capacity dynamo, the armature of which is to be attached directly to the shaft of the engine, while the speed of the latter is not permitted to exceed 300 revolutions per minute, and they are required to be capable of a continuous performance of 72 hours under maximum load, and not consume more than eight horse power with each frictional load, running the generators with their brushes off. Their governors are to be so designed that in case of breakage or any accident the engines will come to a standstill, and the regulation of the engine is to be so adjusted that the governors will govern within three per cent. from full load to no load. The dynamos, at 125 volts, are to have a normal output of 925 amperes each. The total capacity of the four machines will be about 8,000 16 candle power lamps, but the current will not be required for illumination only, as it can be applied to the operation of motors driving cancelling machines, ventilating fans, hoisting apparatus and other purposes. The dynamos are to be of the multipolar pattern, having internal armatures of the Gramme wound type. The field magnets of the generators are to be compound wound and three per cent. over-compounded. These generators are required to carry their full load for at least 12 hours' continuous run, and also be capable of carrying 25 per cent. overload for one-half hour without dangerous heating in any part. The steam for the operation of the plant will be furnished by boilers now in the building, through a 10 inch high pressure steam main, and the piping will be arranged with individual stop valves, so that each engine and generator can be worked independently, or they can together discharge their output to the bus-bars of the switchboard provided to receive and distribute the current throughout the building. The switchboard will be of marble. The mains from the dynamos to the switchboard are lead-covered cables. These cables are run from the generators in iron conduits placed in the floor of the engine room, and terminating in suitable connections at the bus-bars. On the marble switchboard are arranged the necessary devices for the regulation and distribution of the current, including automatic double-pole magnetic cut-offs for the dynamos, an illuminated dial Weston voltmeter, reading 225 volts, and four illuminated dial Weston ammeters of 1,000 amperes each. There is also provided a ground detector, with illuminated dial. The switchboard is to be set upon solid iron columns, inclosed in hollow cast-iron ornamental pedestals, and is to be equipped with ornamental scroll-work. From the switchboard the feed wires ascend to the distribution tablets, located on the various floors. There are to be four of these tablets on each floor, of highly polished pink or Tennessee marble, having on their face a pair of polished copper bus-bars, and copper double-pole, highly polished lever-jaw switches for each tap or branch wire taken from the tablet. These points of distribution are fed from the switchboard by individual systems of wiring. From these different tablets are distributed the wiring to the combination gas and electric light fixtures, with which the building is to be subsequently provided. The tablets are to be set in the walls at the various places to be selected, and to be provided with a glass cover and hinged frame. The wiring of the building is all to be run in iron-armored conduit having an interior and non-corrosive water-proof lining. These conduits are to be laid on the various floors of the building and buried in the cement. The engine room will be tiled and furnished with the latest and most approved system of ventilation and general furnishings. It will present a handsome and attractive appearance when completed. The plant will represent the latest standard isolated electric light practice, and in view of the character of the work there is likely to be keen competition to secure the contract, the representatives of the largest electrical construction companies of the country having expressed an intention to compete for it.

The plant of the United States Electric Lighting company was badly damaged by fire November 20th. The fire originated in the room where the incandescent system was controlled, and the principal damage was sustained there. The flames were first seen at the mouth of the conduit through which the cables enter the building. As soon as the fire was discovered the engineer shut down all the engines and took all precautions against any boiler explosions in the event the fire should reach the boiler room. This had the effect of extinguishing all the lights in the city furnished by that company and gave the impression that the damage was far greater than it really was. The fire also crippled the city post-office service, as the canceling machines were run by current furnished by this company, and all the available men were put to work canceling mail matter by hand.

T. I. P.

PERSONAL.

J. G. Nolen of the Western Telephone Construction company, after a serious illness of nearly two months, is once more actively to the front.

Arthur Howland, secretary of the Anchor Electric company of Boston, is visiting Chicago. Mr. Howland is spending his vacation in Chicago with a few personal friends.

Prof. Herbert Gaytes, formerly of the Armour Institute of Technology of Chicago, has been appointed electrical engineer for the Oakland, Cal., Street Railway company.

Lord Armstrong, who is chiefly known for his improvements in cannon and for his connection with one of the largest manufacturing establishments in the world, has given some attention to electricity, and has just published what is probably the most sumptuously printed work on that science, entitled "Electric Movement on Air and Water, with Theoretical Inferences,"

Mrs. Leroy Ransom, a granduiece of Benjamin Franklin, died at the residence of her son, Charles Ransom, at Homestead, Pa., on November 23. She was born 98 years ago at Richmond, Va. Her maiden name was Malinda F. Franklin. She was twice married and had 13 children. Five of her sons enlisted in the Union army and four were killed on the field of battle, Charles, the youngest, being the only survivor. Mrs. Ransom went to Homestead with her son 12 years ago, was remarkably bright and active for her age, and kept house until within a few weeks of her death.

Roswell Hart Rochester, treasurer of the Western Union Telegraph company, died suddenly on Saturday last at his home in Englewood, N. J. Mr. Rochester, who was 58 years old, was apparently in good health up to within a short time of his death, and had enjoyed a drive into the country during the afternoon of the day upon which he died. Heart trouble was the cause of his death. Mr. Rochester belonged to the pioneer family from which Rochester, N. Y., derived its name. He was born at Gates, Monroe County, New York, on August 17, 1830. He entered the service of the Western Union Telegraph company, April 1, 1865, as a clerk in the office in Rochester. He continued to occupy that place until the executive offices were removed to New York city, when, having discharged his duties acceptably, he became assistant treasurer, a place which was created for him at the instance of O. H. Palmer, secretary and treasurer of the company. On the election of Judge Palmer to the vice-presidency in 1871, Mr. Rochester was promoted to the treasurership of the corporation, which office he had since then held. He was active in the financial management of many religious and charitable institutions, and had served as an executor and trustee of several estates. He was a member of the Sons of the Revolution, and of the Military Order of Foreign Wars. He leaves a widow and one daughter.

Dr. Julius A. Skilton, who died in Brooklyn last week, was a member of the firm of J. A. Skilton & Co., electrical engineers of New York. The deceased had had a career of unusual interest. He was a surgeon in the Civil War, and participated in 27 engagements, at one time being on the staff of General Banks. In 1865 he went to Vera Cruz as a newspaper correspondent, to watch the operations of the French troops. On one occasion he was suspected of being a spy and narrowly escaped death. After the conflict he was made a medical officer in the escort which accompanied General Juarez and his family to Mexico and restored the general to power. Dr. Skilton continued to act as newspaper correspondent until General Grant's election, when he was made consul-general in the City of Mexico, acting also in special matters for England, France and Austria. It was Dr. Skilton who exhumed the body of Emperor Maximilian and sent it to Austria, at the request of the Austrian Emperor Francis Joseph. Dr. Skilton also obtained the release of Maximilian's prime minister, and as a token of gratitude was asked to take the custody of the dead emperor's personal effects. While in Mexico he gave much of his time to archeological research. His collection of relics is now in the Yale Museum. When President Grant's second term expired Dr. Skilton remained in Mexico and became prominent in railroad mining enterprises. About 12 years ago he returned to New York to look after his interests in electrical and other contract work in Mexico, the West Indies and South America. While consul-general in Mexico he had much to do with the establishment of the missions of the Methodist Episcopal Church in and near the City of Mexico. He was a member of Lafayette Post, G. A. R., of Brooklyn.

ELECTRIC LIGHTING.

Terrell, Tex., is urging the establishment of an electric light plant.

The work of enlarging the electric light plant at the Statesville, N. C., cotton mills has been completed. The mills now have a 450 light dynamo.

Preliminary steps have been taken to reorganize the old Ocala (Fla.) Electric Light company, which for several years has been in financial difficulties.

The new Warren induction alternator of 3,000 sixteen candle power lamps capacity for the electric light plant at Brenham, Tex., which, on account of the quarantine regulations, was tied up at New Orleans for the past two or three months, has at last reached its destination, and the people are rejoicing.

The War Department, through the Corps of Engineers, is inviting sealed proposals until December 23d, for furnishing and setting up an electric lighting plant at Fort Monroe, Va. Prospective bidders can obtain specifications and information concerning the contract upon application to Capt. Thomas L. Casey, 166 Granby street, Norfolk, Va.

The electric light company at Mobile, Ala., is now engaged in making extensive repairs to the machinery, and an addition of a 500 horse power Corliss engine. The building is being enlarged and the foundation is being laid for a brick smokestack 80 feet high. When completed this company will possess one of the finest and most complete electric lighting and power plants in the South.

ELECTRIC RAILWAYS.

The Richmond Traction company has a new device to be used when the hose are placed over the tracks. An iron bridge over the hose will enable the cars to run.

The storage battery house for the Richmond Railway and Electric company is about completed, and electricians will shortly be ready to look after the equipment of the plant.

The Salisbury (N. C.) Street Railway and Electric company, recently organized, has applied to the Board of Aldermen of Salisbury for a franchise to operate a street railway in that town.

Receiver F. W. Oakley sold the property of the Madison, Wis., Street Railway company on December 1st under foreclosure proceedings. C. R. Newcomb of Cleveland, representing the bondholders, bid in the road for $110,000.

The Prussian railway minister, Herr von Thirlen, has decided next year to substitute electricity for steam on the railway between Berlin and Potsdam, in order to test the adaptability of the electrical locomotive for general railway traffic. The engineers maintain that traffic conducted by electricity will be both cheaper and faster than the present system,

The line between Berlin and Potsdam, on account of its many suburban stations, is one of the busiest in the whole of Germany.

The Alexandria, Va., City Council has passed an ordinance fixing the speed of the electric trains running through the city at not more than eight miles an hour; also, an ordinance making it incumbent upon the electric railway company to place improved pick-up fenders upon all of its motor cars.

Receiver Jump of the Street Railway and Electric Light company of Terre Haute, Ind., has reported to the court that the total indebtedness is $1,338,517. In this amount is $250,000 in bonds issued as collateral for floating indebtedness. There are first-mortgage bonds to the amount of $400,000, second-mortgage bonds $542,000, interest $8,883, taxes $10,000, street improvements $52,634, and floating indebtedness $325,000. The receiver says he is unable to make a report of the inventory at present because some of the machinery was bought conditionally, and there is from $5,000 to $11,000 due from the Michigan City Trolley Line company, of which Russell Harrison of the company is president, and which was furnished with supplies and equipment from this plant.

Consul Boyle has written an interesting report on the dock system of Liverpool, in the course of which he says: "Closely identified with the dock system, but yet under an entirely separate management, is the overhead [elevated] electric passenger railroad, which runs along the entire line of docks on the Liverpool side. It was built four years ago, and is satisfactorily successful financially. The electric current is carried by a central third rail. This line is used not only by business and laboring men whose occupations are in connection with the docks and shipping interests, but by the general public as a quick and convenient means of transit from one end of the city to the other. There is an ambition that it is but the beginning of an overhead 'belt line' around the city, after the example of a number of American cities."

TELEPHONE.

Ninety-five subscribers were added by the Richmond Telephone company in November.

The secretary of state of North Carolina has issued a charter to the Dunn and Lillington Telephone company; capital, $5,000.

The Hickory and Newton Telephone company is making arrangements to extend its telephone line from Claremont, S. C., to Catawba.

The Southern States Telephone company has extended its lines and now connects with the Hampton and Old Point Telephone company.

Work is rapidly progressing on the new telephone exchange at Concord, N. C. The exchange will have a capacity of 140 telephones, about 80 of which are already subscribed for.

The Southwestern Telegraph and Telephone company has secured the right-of-way for an extension of its lines to Wharton, Tex., giving that city connection with every prominent point in the state.

The Southern Bell Telephone and Telegraph company's connection up Broad street, Richmond, has been completed and many new poles erected. The Richmond Telephone company's men are hard at work running new lines, and the sub-exchange in Manchester is now ready for work.

The railroad commission at Raleigh, N. C., has rendered a unanimous decision, annulling all previous orders regarding telephone rates. Attorney-general Walser advised the commission that it did not have the power to fix the price of telephones, but only the transmission of messages. As a result of this action the Long-distance Telephone company will soon extend its lines in the state.

ELECTRICAL SECURITIES.

The Akron Street Railway and Illuminating company of Akron O., has issued $1,500,000 five per cent. 30-year first consolidated mortgage gold bonds, which are offered for sale at 95 per cent. by Sutro, Scholle & Co. of New York and H. F. Bachman & Co. of Philadelphia. The company's earnings for 1896 were $210,246.59 and its expenses $123,769.51. The company is free from floating debt except its current monthly bills. Samuel Thomas of New York is its president. The Manhattan Trust company is trustee of the mortgage.

MISCELLANEOUS.

The 2,000 horse power electric plant on Yadkin River, 13 miles from Winston-Salem, N. C., is well under way, and will be in operation next February. It will furnish power for street cars, mills and factories, and electric lighting for not only Winston and Salem, but all towns within its circuit, and this embraces a large and prosperous territory.

The Mathieson Alkali company of Niagara Falls has started one unit of cells in the new works, which are located on the property of the Niagara Falls Power company, the electric power being supplied from the latter company's central power station. That portion of the plant now in operation represents only about one-tenth of the total capacity of the works. The remaining cells will be started as soon as they are in readiness for operation. The product of the plant will be caustic soda and bleaching powder. The works are among the most extensive of the electro-chemical plants at Niagara Falls.

The lighthouse at Punta Brava, Venezuela, about one mile north of the harbor, is at present using an ordinary ship's lamp, but the electric light at the wharf, sometimes seen at a distance of 30 miles at sea, furnishes the mariner with a certain guide to port. The United States consul at Puerto Cabello, says: "The cable line from here to La Guayra, thence to Curacao, Hayti, and to New York has proven of infinite service to the merchants of Puerto Cabello. Its present reliability has been productive of its more frequent use, and merchants' cable orders to New York for goods have increased. The telegraph system of the country is owned and controlled by the national government. The rate charged for messages is much less than in the United States."

TRADE NEWS.

The Massachusetts Chemical company of Boston has hit upon an excellent idea in the way of special advertising. Its latest contribution to the fable series is number 9,999,999.

The Wright demand system for charging, which was discussed at the last convention of the National Electric Light association and also by the Association of Edison Illuminating companies, is being exploited by R. S. Hale of 31 Milk street, Boston.

The partnership between W. W. Burnham and James L. Gethins at 181 Tremont street, Boston, under the name of the Burnham-Gethins company, was dissolved November 24th. Mr. Burnham announces that he intends to do the same kind of business hereafter on his own account.

A very handsome paper weight, showing the special features of construction of a car wheel, is being sent out as a souvenir by the Griffin Wheel company. The names of the cities in which this company has foundries—Chicago, Detroit, Denver, St. Paul and Tacoma—are cast on the wheel to remind purchasers of the facilities which the company possesses for filling orders.

General Agent J. P. Williams of 39 Cortlandt street, New York, has returned from a three weeks' trip through the Central and Western states. He took with him a full line of the 1898 Paragon fan motors, and reports that the results of his trip far exceeded his anticipations. The indications point toward the Paragon being more prominently identified in the desk and ceiling fan business than last year.

Few companies have made such an excellent reputation in so short a time as the Farr Telephone and Construction Supply company, 342 Dearborn street, Chicago, which supplies anything used in connection with telephone and construction work. One of its special features is the promptness with which orders are filled and the general satisfaction its goods give to users. A little book containing general information on the construction and maintenance of telephones will be cheerfully sent to anyone on request.

William Roche of 259 Greenwich street, New York, has recently undertaken the manufacture of a dry battery which will be known as the New Standard. Mr. Roche has had a number of years' experience in the manufacture of dry batteries. He is the inventor of the Exeter dry battery cell, which was given such prominence at the World's Fair in connection with the opening ceremonies. In connection with the manufacture of batteries he will also take up a line of special apparatus to meet particular conditions. Mr. Roche has been connected with the Manhattan Supply company of New York.

"We have the largest number of orders to fill, and are running our factory more hours per day, than at any time during the last two years," was the cheerful reply of H. Durant Cheever of the Okonite company of New York, when questioned as to the comparative demands of the present business and that of the last two years. Mr. Cheever further stated that if the present rush of orders continued the company would find it necessary to either increase the present facilities for manufacturing or refuse orders. The high standard which has always been maintained in the manufacture of Okonite wire is well known to the electrical trade, and it is a pleasure to note that a large share of this well-known product is purchased in the central and western states.

The prospective purchasers of arc lamps will be pleased to learn that the Clark Electric company has recently added to its facilities for producing its lamp in larger quantities in order to meet the demand of the trade. The company commenced the manufacture of arc lamps about eight years ago, having in mind the special purpose of lighting all classes of stores, offices and factories. It also manufactures a high-grade arc lamp for street illumination. The standard has been maintained in all improvements, and in consequence the company has found steady demand for the product. Among the installations in New York are those of B. Altman & Co. and the New York Herald. The Clark Electric company is now located in the Postal Telegraph building, 253 Broadway, New York.

Two exceedingly interesting and valuable contributions to catalogue literature are recent publications by the General Electric company. One is on Edison incandescent lamps for electric railway service. It is claimed that the best quality of street railway lamps may be so misused as to make the lamp worthless, but that by proper use a maximum of life and light is obtained The conditions of proper use require that only lamps of same amperage or make be burned in the same car or series, that lamps be ordered to suit the total voltage of the circuit, and that lamps be replaced by new ones whenever they get old and dim. This last requirement is necessary if light is to be economically produced. A treatise upon the "Operation of Electric Mining Plants" deals particularly with the electric haulage system, and contains much valuable data.

BUSINESS.

A testimonial sheet, giving the opinions of users of Schoonmaker's mica, is issued by A. O. Schoonmaker, 158 William street, New York. All the writers unite in the opinion that this mica gives complete satisfaction in electrical service.

The Pittsburg and Lake Superior Iron company of Whitney, Mich., is highly elated over the fact that the Central Union Telephone company of Chicago has accepted its bid to furnish 60,000 telephone poles. The contract aggregates over $100,000 and is one of the largest ever let.

The necessity of providing suitable lamps for use in surgical and dental work has led the American Endoscopic company of Providence to bring out a complete line of incandescent lamps for this purpose. These are thoroughly described in the illustrated catalogue just issued by the company.

The works of Julius Fuchs in Nuremberg are now controlled by Schiff, Jordan & Co. of Vienna. Mr. Fuchs has manufactured the "Electra" carbons for a number of years, and will hereafter have charge of the manufacturing department of the Vienna works, as well as the Nuremberg plant. Mr. Fuchs has recently made great improvement in carbons for alternating current and for the enclosed arc lamp sold exclusively by Schiff, Jordan & Co. of 232 and 234 Greenwich street, New York.

McKinlock & Camp, agents for the successors of the Metropolitan Electric company, returned from their eastern trip last week. Mr. McKinlock reports the revival of many pleasant old acquaintances, and he further announces that he and Mr. Camp now feel that their prospects for meeting with success in their new enterprise are better than ever. Messrs. McKinlock and Camp are still pushing the remainder of the Metropolitan company's stock and report a number of orders for slices of that cake.

In an interview with F. E. Dolbier, manager of the arc lamp sales department of the General Incandescent Arc Light company, he is reported to have said that the success which the concern is meeting in the sale of the enclosed arc lamp denotes the popularity of this product, and the satisfactory service obtained by the use of the lamps of this type. He mentioned that the company had just closed a contract for the installation of Bergmann enclosed arc lamps in the new addition of Bloomingdale Brothers' dry goods store in New York city.

A sign adaptable for public telephone pay-station service is proving one of the most attractive novelties that has yet been introduced by the Stromberg-Carlson Telephone Manufacturing company of Chicago. The company is now sending out a handsome card in colors advertising this telephone sign and advising all independent telephone companies to thus "show their colors" by having their signs marked "Independent." This sign is made of the best enameled iron with heavily baked enamel. The size of the sign is 8 by 2½ inches. Both sides have the American shield in a large, white block at one end, with the original 13 stars in a blue field, and red and white stripes, with the word "Independent" in bold letters across the face of the shield. The main part of the sign is of a blue ground, with the words "Public Telephone Pay Station" in large white letters. The sign is made with a flange for fastening against wall or post, and holes for suspending. It has no mark of the manufacturer, and is intended expressly for independent public telephone exchanges.

An improvement in manufacture has recently been perfected which makes the Packard lamp a practically smokeless lamp. A difference is very easily perceptible, it is said, when one of the smokeless Packard lamps is allowed to burn beside a lamp of some other make. The improvement produces a lamp which, it is claimed, is practically undimmed to the end of its life. There is no perceptible blackening of the globe even during a life of 800 to 1,000 hour. The improved process is being rapidly applied to all of the lamps made by the Packard company, and the entire product will soon be made up of smokeless lamps. The Electric Appliance company,

the general western agent for the Packard lamp, has been making some interesting tests along this line, and reports that the new lamp is a wonder. The trade will soon have an opportunity to determine for itself the merits of the smokeless lamp by comparative tests, and it is believed that the results will be very largely in favor of the Packard lamp. The Electric Appliance company is looking for a largely increased business.

Timmis & Clessold of Bound Brook, N. J., call attention to the Carhart friction clutch which they manufacture. This clutch consists of a sleeve mounted upon a shaft and secured with set-screws or keys, and upon the sleeve the pulley is mounted so that it may revolve, the pulley having an annular flanged hub of suitable diameter to engage with two bell-shaped clamping collars. These collars are connected and driven with the sleeve by means of two or more diametrically opposite lugs and two or more keys at either end, the front collar carrying two or more levers which have U-shaped recesses, and are cam faced, and have engagement with the sleeve lugs, compressing the pulley disk between the front and rear collars, making a firm and compact arrangement. In releasing the clutch, the loose spool is thrown in the opposite direction or away from the sleeve, bringing the U-shaped recess in contact with the opposite side of the sleeve lug withdrawing the front collar, at the same time allowing the pulley to run free upon the sleeve and between the collars. The sleeve is provided with a nut for adjustment. The oil canal is for oiling the exterior of the sleeve and bore of pulley. Carhart clutches are fitted with bronze bushings. Graphite bushings are also furnished when desired.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued November 23, 1897.

593,981. Apparatus for Electrically Heating Metals and Ores. George D. Burton, Boston, Mass. Application filed February 20, 1897.

A tank contains an electrolytic solution; a hearth is elevated above the plane of the sides of the tank; a reservoir is elevated above the hearth, and means for elevating the liquid from the solution in the tank into the reservoir and means for supplying an electrolytic solution to the hearth from the reservoir are provided.

593,986. Separable Recording Meter. James R. Cravath, Chicago, Ill. Application filed August 12, 1897.

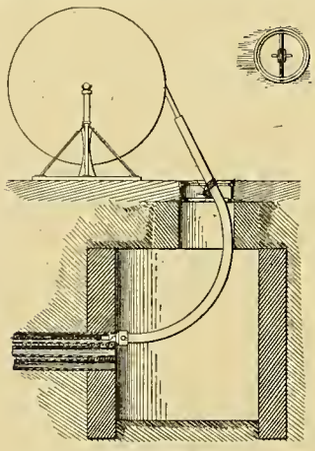
The actuating parts of an electric recording meter and a box carrying the recording mechanism, with separable gearing connecting the recording mechanism and the actuating parts of the meter and permitting the removal of the box, are described.

593,988. Resistance Device. George K. Cummings, Chicago, Ill. Application filed December 23, 1895.

Terminal rods are supported on cross-pieces, two of the latter being movable; a number of tubes containing electric resistance material of constant density are supported between the movable cross-pieces, and means for adjusting the tubes on some of the terminal rods are described.

594,020. Apparatus for Feeding Cables into Underground Conduits. Willbur H. Johnston, St. Louis, Mo. Application filed July 28, 1897.

The cable may be passed through a curved tubular guide and adapted for insertion within the manhole; means for bringing an end of the guide into communication with a duct communicating with the manhole, through which duct the cable is to be threaded, and means for securing the curved tubular guide in position at the manhole opening, permitting the sidewise movement of the guide by the cable as it is unwound, whereby the guide is maintained in alignment with the unwinding cable, are described.



NO. 594,020.

594,034. Automatic Circuit Controller. Charles W. Price, Newark, N. J. Application filed March 23, 1897.

An electro-mechanical controller for an electric circuit comprises a spring-driven motor, holding devices for the motor, an electro-magnet in a normally closed local circuit for operating one of the holding devices, another electro-magnet in a normally open local circuit for operating the other of the holding devices, a main circuit and two circuit-controlling disks for the main circuit and operated by the motor.

594,036. Röntgen Ray Tube. Henry L. Sayen, Philadelphia, Pa. Application filed April 29, 1897.

As a means for varying the pressure in a high vacuum tube a main circuit is provided for operating the tube and a shunt circuit for varying the pressure.

594,060. Telephone. Theodore Berdell, New York, N. Y. Application filed December 27, 1895.

A telephone in which are comprised two diaphragms unencumbered at their centers and held apart at their peripheries in an insulating case, a ring of insulating material held between the diaphragms, and spherical or granular material loosely held in the space outside of the ring, the space between the diaphragms within the ring being unoccupied.

594,069. Means for Regulating Operation of Elevator or Traveling Cars. Frederick L. Emery, Lexington, Mass. Application filed December 11, 1896.

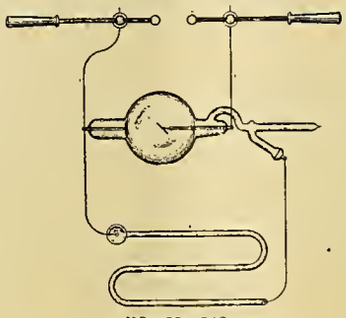
Electrically controlled means insure the movement of the cars in desired order, one with relation to another, and circuit-controlling devices operated by movement of the cars govern the means, some of the circuit-controlling devices after movement by a car automatically resuming original position when released by movement of the car, while others are always in position where left by movement of a car until positively changed into different position by movements of a different car.

594,122. Indicator for Underground Electric Railways. Harry C. Reagan, Jr., Philadelphia, Pa. Application filed June 4, 1896.

Details of construction include an insulated continuous sectional conductor, energizing means for its sections, brushes or other contact devices carried upon each end of a car and adapted to contact with different sections of the conductor, an indicator connected with each of the brushes, a resistance coil connected with the indicators and a wire from the resistance coil grounded in the frame.

594,131. Bell Extension for Telephones. Ernest S. Dickerson, Philadelphia, Pa. Application filed August 11, 1897.

When the call-bell lever oscillates the flexible arm will periodically engage the contact, a local battery circuit wherein the contacts are included, and one or more signaling devices included in the local battery circuit.



NO. 594,143.

594,143. Regulating Röntgen Ray Tubes. Martin P. Rice, Schenectady, N. Y. Application filed July 17, 1897.

An automatic vacuum adjuster for Röntgen ray tubes consists of a shunt circuit including in the path of the current a volatile salt within the vacuum inclosure, and a high resistance in lieu of the usual spark gap.

594,144. Regulation of Alternating Current Systems. Charles P. Steinmetz, Lynn, Mass. Application filed December 22, 1893.

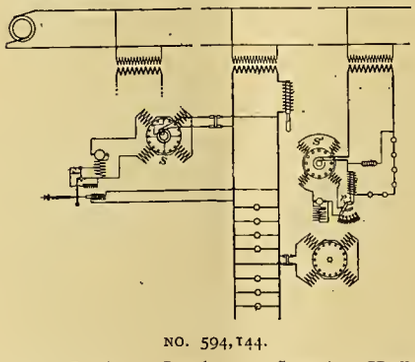
The method of localizing or rendering independent two or more sub-circuits or portions of an alternating system supplied from common mains consists in adjusting to different conditions the self-induction and the displacement of phase of electromotive force and current in such different portions.

594,145. Inductor Dynamo. Charles P. Steinmetz, Schenectady, N. Y. Application filed August 12, 1897.

A polar inductor and an annular magnetic structure recessed to receive the armature coils, and having its magnetic reluctance increased by an air gap or gaps of high reluctance compared with the reluctance of the armature iron.

594,150. Starting Device for Alternating Current Motors. William J. Foster, Schenectady, N. Y. Application filed January 4, 1896.

As a means of increasing the starting torque of a synchronous alternating current motor, a bridge of magnetic material adjacent to the polar faces of the induced member is utilized.



NO. 594,144.

594,155. Section Insulator. Joseph Hoffman, Schenectady, N. Y. Application filed August 7, 1897.

A main portion or body of insulating material and metallic end pieces are secured to the main portion, and have a transverse flange or rib engaging the main portion.

594,156. Röntgen Ray Tube. Irwin W. Howell, Newark, N. J. Application filed August 26, 1897.

This vacuum tube has in shunt to the main discharge path a second discharge path through a gas-producing agent in the same vacuous space with the main discharge path, and serving to regulate the vacuum in the main bulb.

594,192. Automatic Electric Burglar-alarm. John W. Baughman, Dalton, O. Application filed March 25, 1897.

An electric alarm system is described, comprising the vibrating bell, having the terminal connecting posts, the lever provided with a pin projecting into the path of the hammer arm, a conductor connecting the lever with the post, a contact located in the path of one end of the lever and in electrical connection with the post through the conductor, post, magnet and conductor, the contact post connected to the terminal post by the conductor, and the local battery having its poles connected to the terminal posts, in combination with the alarm circuit, its battery and spring connections.

594,247. Electric Cable. John D. Gould, Brooklyn, N. Y. Application filed January 11, 1897.

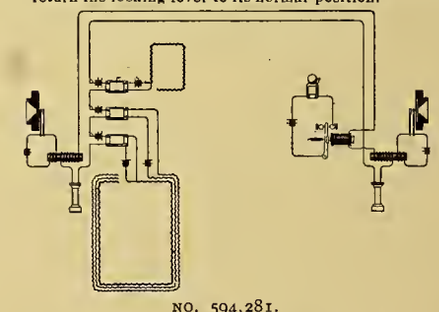
An electric cable is described, comprising a fusible core, a copper or similar wire extended longitudinally through the core, an insulating material covering the core, a series of conductors wound spirally around the insulating material, and an insulating cord wound spirally around the insulating material between adjacent spirally wound conductors.

594,256. Electric Railway Signal and Safety Device. Koby Kohn, Seward, Neb. Application filed March 8, 1895.

An electric conductor is arranged alongside the track, and devices on the train maintain electric contact with the conductor. There are connected the steam valve, the lever carried by the spindle of the valve, the armature engaging the lever, the coils and the wire connections for energizing the same, the rod normally pressed outward, and pivoted movable connections between the rod and the upper end of the lever.

594,281. Automatic Signaling System. Charles W. Price, Newark, N. J. Application filed January 11, 1897.

An electro-mechanical controller for an electric circuit is described, comprising a motor, a screw-shaft operated by the motor, a circuit making and breaking disk for a main circuit on the screw-shaft, a pivoted lever movable by the screw-shaft and adapted to stop the motor after a certain number of rotations of the circuit-controlling disk shall have been made, an electro-magnet in a local circuit, an armature lever operated by the electro-magnet for releasing the motor, a spring-plate for locking the armature lever and a lever serving to move the spring-plate out of engagement with the armature lever, and also serving to return the locking-lever to its normal position.



NO. 594,281.

594,313. Storage or Secondary Battery. Ralph Ashley, Port Republic, N. J. Application filed April 25, 1896. Renewed July 17, 1897.

An electrode for a storage or other battery consisting of the horizontal, straight and corrugated metal strips alternating with each other, and the spacing pieces between the ends thereof and soldered thereto.

594,323. Means for Indicating Movement or Cessation of Movement of Fluid. Orville Carpenter, Pawtucket, R. I. Application filed December 5, 1896.

The device described comprises a body in a fluid, the body being heavier than the fluid and arranged to be moved by the pressure of the fluid when the fluid is in motion, and a magnet exterior of the fluid and body, and so arranged that the body may come within and leave the field of the magnet to cause a disturbance thereof.

594,346. Heat Regulating Apparatus. Charles L. Fortier, Milwaukee, Wis. Application filed September 12, 1896.

The combination is claimed with a heat-regulating valve or damper of an electro-magnet for controlling the operation of the valve or damper, an electric circuit connecting the coil of the magnet with a source of electricity and a shunt containing a thermostat and tapping the circuit on opposite sides of the magnet.

594,363. Telephone System. Alfred F. Swan, Bayonne, N. J. Application filed December 10, 1896.

Claim is made for the combination with the telephone apparatus, the line and the switch-barrel having means for stepping it around, of a triple series of circumferentially arranged insulating and conducting strips on the switch-barrel, a set of brushes to contact with one series of conducting strips and cut the bell to line, and the talking set into the line circuit controlled by the telephone hook, a second set of brushes arranged to connect with a second series of conducting strips and cut the talking set to line, a second set of brushes to contact with the third series of conducting strips and cut the talking set and bell out by short-circuiting, and suitable connections between the brushes, the telephone apparatus and the line.

Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, DECEMBER 11, 1897. No. 24

Electrical Equipment of the South Side Elevated Railroad.

About the middle of July last the work of changing the South Side elevated railroad of Chicago, better known as the Alley "L," from steam to an electric road was started, and has been progressing quietly but none the less vigorously since that time.

The outside electrical construction is now so near completion that the Western Electrician is enabled to publish herewith several photographic views and a synopsis of the work and the methods employed in its execution.

The object of the engineers, Messrs. Sargent and Lundy, seems to have been to employ standard methods and material whereever possible, and so far as the construction work is concerned this determination has proved to be wise.

One hardly appreciates at first glance what it has meant to the railroad company, the contractors or the engineers to do the work above mentioned without accident or interruption to the very frequent train service of an elevated railroad.

The outside electrical construction naturally falls into three main divisions: first, track bonding and return circuit; second, third or trolley rail; third, feeder system.

For the return circuit the four service rails and the entire steel structure of the road is used, being made common by a system of bonding and cross-bonding and connections between the rails and longitudinal girders. Standard No. 0000 copper bonds are used at each rail joint, the track being cross-bonded at frequent intervals, and these cross-bonds in turn connected with the structure at still greater intervals. This work necessitated the drilling in the service track rails and structure about 20,000 seven-eighth inch holes, and the placing of 10,000 rail and other copper bonds. Owing to the presence of the wooden guard-rail on either side of the track rail the drilling of this great number of holes in anything like an economical manner was for a time a perplexing question. With the use of an electric motor, a flexible shaft and a compact little drill press which operated in nine inches of space, the work was easily and rapidly carried on. A good idea of the appearance of the apparatus will be had by reference to Fig. 1.

The two drilling outfits were designed and built especially for this work by the Electrical Installation company of Chicago, and caused much favorable comment by all who witnessed their operation, except candidates for jobs working hand ratchet drills. During certain hours of the day, when a stretch of track between two cross-overs could be had, these little wagons were run along on the guard-rails, their wheels being flanged and made to fit a 15-inch gauge, the distance between guard-rails. At other times, when the schedule would permit of the use of but one track, it was necessary to do the drilling between trains, sometimes on two minutes' headway.

The men handling these drilling outfits became so expert in their use that the attaching and detaching of the drill presses to the rail was accomplished with a rapidity and precision that was remarkable, and reduced the time lost by the passing of trains to a minimum. Then, again, the rivalry between two drilling crews was so sharp that personal encounters were often imminent. As a precautionary measure, a red flag was always placed between the workmen and an approaching train, this flag being pulled only when the track was clear.

During the progress of the entire work on the service rails of the South Side Elevated Railroad company not a train was held over 10 seconds, and the few delays were simply due to the precaution exercised by the drillers in not allowing a train to pass when there was a possible danger to it or the workmen.

For the third or trolley rail a 60-foot 40-pound T-rail is used, which is double bonded with horseshoe bonds and is mounted on the General Electric company's standard third-rail insulator. A view of the contact rails in place is shown with the feeder cables in Fig. 3. A glance at the picture of the feeder system, which was taken at Michigan avenue and Fortieth street, will give a clearer idea of what it consists of than any amount of descriptive matter. It may not be amiss, however, to state the quantity of copper used and the method employed in erecting it. From the power house, which is located at State and Fortieth streets, immediately adjacent to the elevated structure, there extend southward five bare copper cables with a total sectional area of 5,500,000 circular mils, and northward from the power house three cables of a sectional area of 2,500,000 circular mils. In all there are about 24 miles of copper cable in use weighing about 200 tons, and worth, at the present market prices, about $55,000. As will be seen in Fig. 3, these cables are supported by standard cross-arms, iron cored pins and glass insulators, iron-clad insulators being used wherever additional strength is required. The cables are of three sizes, 1,500,000, 1,000,000 and 500,000 circular mils, the first being supplied in 1,000-foot lengths, the second in 1,500-foot lengths, and the third in 3,000-foot lengths, and one length to a reel, which weighed about 2½ tons each.

Fig. 1. Electrical Drilling Outfit for Bonding.

Fig. 2 Hauling Feeder Cable on the Structure.

Fig. 3. Bare Copper Feeders in Position.

ELECTRICAL EQUIPMENT OF THE SOUTH SIDE ELEVATED RAILROAD.

The engineers exacted that the cable must not be cut, and permitted only as many splices or joints as there were reels of wire. Their specifications also provided that the cables be run under the structure at the 15 track cross-overs. How best to pull these heavy cables along the structure, down beneath it at cross-overs, and then back to the normal position, without injury to the cables, was somewhat of a problem; it was extremely easy of execution, however, with the aid of sheave wheels mounted in rigid wooden frames, and a locomotive to do the pulling. The stringing of all the feeder cables had to be done between the hours of 1 and 5 a. m., in order not to interfere with traffic, but the greater portion of the work was done by daylight. The day crew distributed reels at predetermined points, setting up the reel stands and sheave frames, arranging the tackle so that the night crew, with its locomotive, had simply to hook on to the end of a cable and pull it into place, the reels being always on the ground under the structure, as is shown in Fig. 2. In this manner a 3,000-foot length of 500,000 circular mils cable was pulled into place in a surprisingly short space of time. Another day crew was employed in the splicing, stretching, tying in and otherwise finishing the work. To protect the feeders from accidental contact, and serving in addition as a walk, there is built over them a wooden box, which is now being laid at the rate of about

3,000 feet a day. This covering it not shown in the picture.

For the speed and excellence of this work credit is due the Electrical Installation company, which did all of the outside construction, with the exception of laying the third rail, and which has also the sub-contract, under the Sprague Electric company, for the remodeling and equipment of the cars. The work was done under the general supervision of Superintendent J. A. Brett, with the assistance of A. H. Stocking, engineer. Walter Halpine was foreman of the outside construction, and George E. Morrine of the car equipment.

In Fig. 4 is shown one of the Alley "L" cars

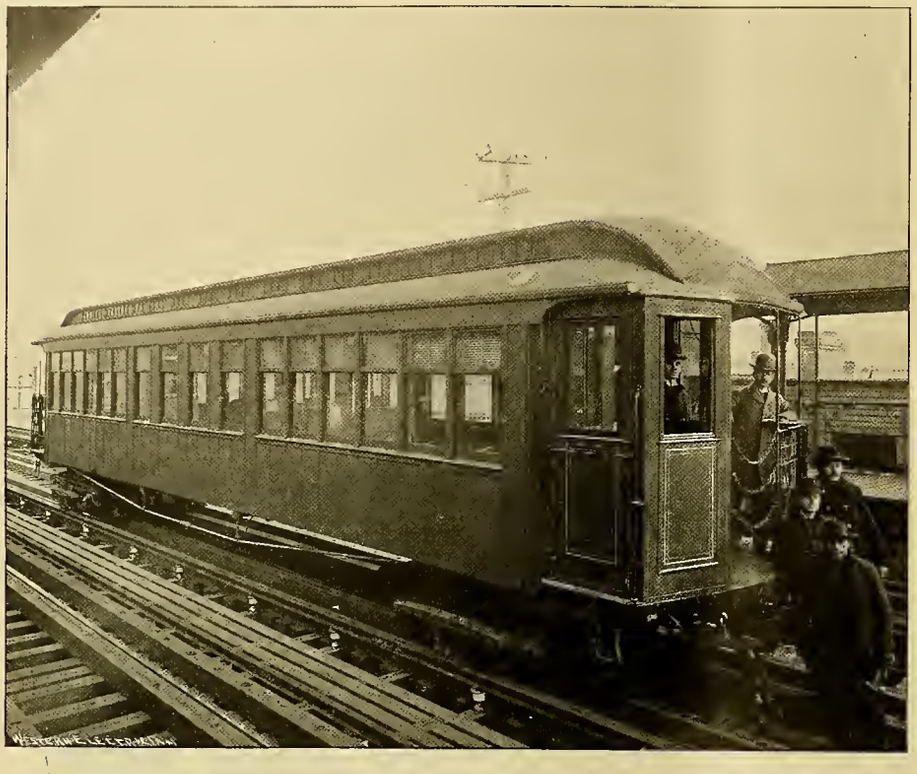


FIG. 4. ELECTRICAL EQUIPMENT OF THE SOUTH SIDE ELEVATED RAILROAD.—CAR FITTED WITH THE SPRAGUE MULTIPLE-UNIT SYSTEM.

equipped for the Sprague electrical multiple-unit system of train propulsion, with folding vestibule. All of this company's cars will be similarly equipped, each being an independent unit, supplied with its own contact shoes, controller, motors, air compressor, engineer's air valve and gauge, electric heaters, etc. Each car may be run by itself or as a unit in a train of any number of cars. A train of these cars is now in daily service on the Metropolitan West Side road, and it seems to be giving entire satisfaction.

The power house for the Alley "L" is nearing completion, and will be completely inclosed within two weeks.

George R. Blodgett Murdered.

Aroused by a burglar in his house at Schenectady, early on the morning of December 3d, George R. Blodgett arose to protect his home. He was unarmed, but advanced toward the marauder, who commanded him to throw up his hands. Endeavoring to avoid the attack or attempting to grapple his antagonist about the legs, Mr. Blodgett threw himself forward. At this moment the burglar fired his revolver, and the ball entered the prostrate man's back, pasing downward over the right kidney. In the ensuing confusion the burglar escaped. Assistance was summoned, and during the day an unsuccessful effort was made to locate the bullet by the use of X-rays. In the evening an operation was performed, but the shock was too great, and the injured man gradually sank to his death, which occurred at 2:30 p. m. on Saturday. Mr. Blodgett was at the head of the legal department of the General Electric company at Schenectady, and that company has offered a reward of $5,000 for the arrest and conviction of the burglar who killed him.

Everything possible was done for Mr. Blodgett by his associates in the company and his neighbors as soon as the shooting became known. It was discovered that the wires leading to the telephone in the house had been cut, but nevertheless the news was widely known before daylight. Local physicians were quickly at Mr. Blodgett's bedside, and a distinguished surgeon from Albany was brought to Schenectady so quickly on a special locomotive that he arrived on the scene within two hours from the time of the shooting. The X-ray experiment failed, it is said, from the fact that the ball lay behind the great side bone of the pelvis, having perforated the intestines.

The burglars—for it is believed that there was more than one—secured little booty, although they had evidently been in the house some time, as two heaps of clothing and silverware were found. They are still at large.

George R. Blodgett was about 38 years of age and leaves a wife and one child. He was a native of Maine, and his parents arrived from Bucksport, in that state, an hour after their son's death in his Schenectady home. Mr. Blodgett was a graduate of Yale, and not long after leaving college he entered the Patent Office as an assistant examiner, after a competitive examination. It is said of him that he passed the best examination and wrote the poorest hand of anyone connected with the department. He was several times promoted, and during this period studied law and was admitted to the bar. He left the Patent Office to practice patent law, and associated himself with the Boston firm having in charge the extensive patent interests of the Thomson-Houston company. After the consolidation with the Edison company Mr. Blodgett became connected with the General Electric company, and when the main office was removed to Schenectady he, with the other officers, became a resident of that town. He was permanently retained by the company at a salary stated to have been $8,000 a year. He was chief solicitor of patents and had charge of the legal staff at Schenectady. As counsel he ranked next to F. P. Fish, the chief counsel of the company. He was highly esteemed by Mr. Fish and the officers of the company, and his shocking death is greatly regretted. As a patent lawyer he was noted for his thorough mastery of the technics of electrical and mechanical applications. He had the working knowledge of a practical electrician as well as the training of a lawyer, and his services were consequently of great value to the company. He was active in advancing and defending the patent interests of the General Electric company. On Tuesday of last week he was in Washington arguing an interference case in the Patent Office in opposition to Frank T. Brown, the Chicago patent lawyer. He stopped in New York on his return, and on his very first night at home, after this journey, he received the desperado's bullet that ended his life.

Determination of the Virtual Electromotive Force of Alternators.

By Karsten Knudsen.

Part I.

The theory is based upon the assumption that the useful magnetic flux is fairly distributed within definite limits. These limits we may consider as the lines which inclose the mean path for the lines of force, or, more clearly defined, the corners of the pole-face. In consequence of spreading of the lines into the armature core, it follows that the hypothesis mentioned does not agree with the truth; but by contemplation of the magnetic flux in alternators mostly used in practice, the investigation will result in that inference, that the theory based upon hypothesis may hold good within practical limits. It is evident that if the pole-face is of large area in comparison with a small air-gap, the amount of lines of force leaking from the corners of the poles into the armature is small compared with the flux direct from the pole-face. Even for ordinary alternators with small pole-face, the estimated voltage agrees fairly with the practical results.

A conductor, when moving uniformly about a fixed axis in a uniform magnetic field, cutting the lines of force, develops an electromotive force, which depends on the velocity of the conductor, strength of the field and angle in which the conductor cuts the lines of force.

Fig. 1 indicates a conductor A, moving in a uniform field between the poles N S about a fixed axis. The vertical parallel dotted lines between the mean paths of the poles represent the lines of force. It will be seen that when the conductor passes 0° the electromotive force is equal to 0, because in that instant the direction of the motion is parallel to the lines of force.

The maximum value of the electromotive force the conductor will develop is reached when it passes 90°, because in that instant the direction of the motion is at right angles to the lines of force. If we consider the maximum value of the electromotive force represented by the radius of the circle, all values between 0° and 90° are represented by the ordinates or the distances from the circumference perpendicular to the line A B. Considering the space above the line A B positive, and that beneath negative, the electromotive force will remain positive over half a circle, or from 0° to 180°, and will then change into a negative value until the conductor has completed the rest of the circle. Two alternations, one positive and one negative, or one complete cycle, have been accomplished in one revolution. The cycle is repeated with every revolution.

We may, however, represent the circumference of the circle by the straight line x x. When the conductor moves uniformly around the circumference of the circle, and has completed one revolution from 0° to 360°, we may represent the line x x from 0° to 360° for the time of one revolution of the conductor.

If we denote by e the variable electromotive forces, and by E the maximum electromotive force, then we have

$$e = E \sin \alpha;$$

e being also a sine function of the time. Connecting the top of all the ordinates we will have the so-called sine curve.

We will now consider the more practical applications of the magnetic field, and the electromotive

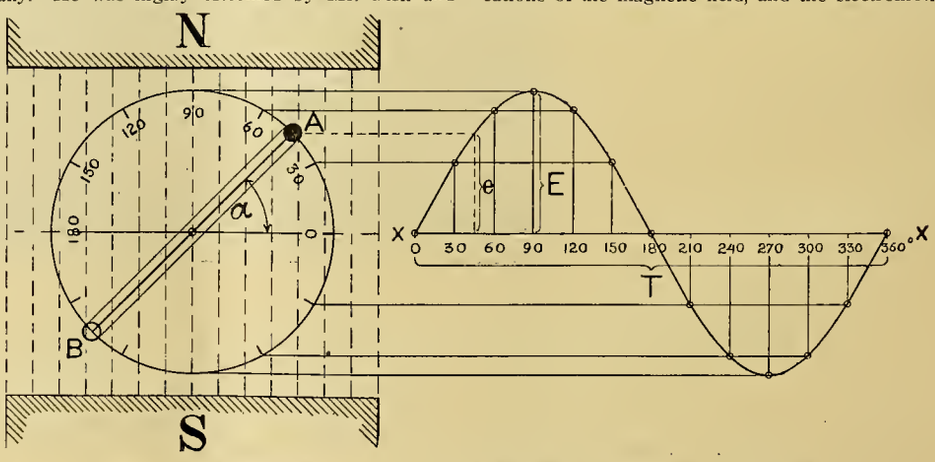


FIG. 1. DETERMINATION OF THE VIRTUAL ELECTROMOTIVE FORCE OF ALTERNATORS.

forces set up in conductors when moving in a field of definite strength.

Fig. 2 represents a field in which the lines of force enter and leave the armature through narrow air-gaps. The lines of force we will consider fairly distributed over the surface of the poles, crossing the air-gaps at right angle to the circumference. We will then have a uniform field over an angle of m degrees.

According to a well-known definition: A unit of electromotive force is produced when a conductor of unit length moves in a field of unit strength with a velocity of unit length per unit time, or one second, and we may write:

$$E = Hlv$$

where E denotes the electromotive force in C.G.S. units, H lines of force per square centimeter, l length of the conductor in centimeters and v the velocity of the conductor in centimeters per second.

If A denotes the area of the air-gap inclosed by the pole, the total lines of force through the air gap is:

$$H\,A = N;\ \text{or}\ H = \frac{N}{A}$$

N = total lines of force. Substituting the foregoing, we have:

$$E = l\,\frac{N}{A}\,v.$$

If the conductors are diametrical on the armature, the electromotive forces in both branches are added, and if C denotes the total number of conductors which a very narrow space may inclose, on both sides of the armature, then

$$E = l\,\frac{N}{A}\,v\,C;$$

but l is equal to the length of one conductor which is under influence of the magnetic field, or, what is the same, equal to the width of the pole; therefore

$$A = \pi\,d\,\frac{m}{360}\,l$$

where m = number of degrees which each pole incloses and d the average diameter of the circles which the moving conductors describe.

Substituting for A we have:

$$E = \frac{N\,v\,C}{\pi\,d}\,\frac{360}{m}$$

but $v = \pi dn$; where n = revolutions per second. Hence:

$$E = \frac{N\,\pi\,d\,n\,C}{\pi\,d}\,\frac{360}{m} = NnC\,\frac{360}{m}$$

This equation gives the maximum electromotive force for the conductors on the armature concentrated into single lines, moving in a uniform field, distributed over an arc of m degrees.

In practice, however, the conductors cover the whole or a part of the armature surface. We must therefore put the equation into another form.

Fig. 3 is a field inclosed by m degrees, and the conductors are distributed over an arc of g degrees. It will be readily seen that the electromotive force will have its maximum when the largest number of conductors cut the field, and the electromotive force will be kept constant over that number of degrees, equal to the difference between g and m, or m and g if m is larger than g.

It is evident that when the arc of the coil does not exceed the arc of the pole, the maximum electromotive force from a wide coil will be the same as from a narrow one, providing, of course, that the number of conductors in both cases is the same. The wide coil we may consider divided into as many sections as the number of times greater it is than the narrow coil. The narrow coil is then under the same influence of the field as each of the parts of the wide coil, but the narrow coil contains the same number of conductors as the combined sections of the wide coil together, consequently the maximum electromotive forces in both cases are equal.

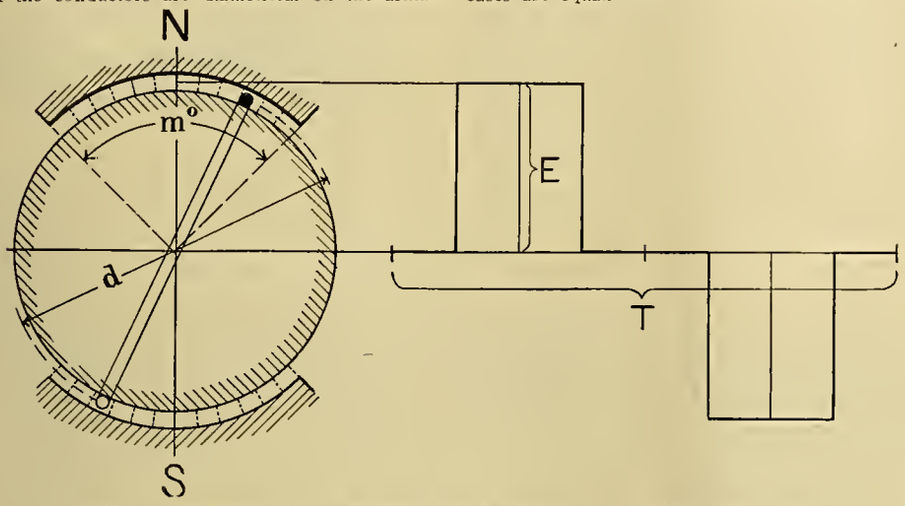


FIG. 2. DETERMINATION OF THE VIRTUAL ELECTROMOTIVE FORCE OF ALTERNATORS.

Denoting by s the number of degrees g is greater than m, the total number of conductors under the influence of the field is:

$$\frac{m}{m+s} \times C.$$

Therefore:

$$E = NC\,\frac{m}{m+s}\,n\,\frac{360}{m} = NCn\,\frac{360}{m+s}$$

This formula gives the maximum electromotive force for conductors distributed over any space of the armature surface.

If we connect the armature conductors with a commutator or convey them into a continuous current armature, we will have two armature circuits in parallel and the equation becomes

$$E = \frac{1}{2}\,NCn\,\frac{360}{m+s};$$

but the conductors in this case cover the whole surface, and s is equal to

$$180 - m.$$

Substituting for s we have

$$E = \frac{NCn\,360}{2\,(m+(180-m))} = NCn,$$

or in practical units:

$$E = NCn\,10^{-8},$$

which is the well-known formula for continuous current dynamos.

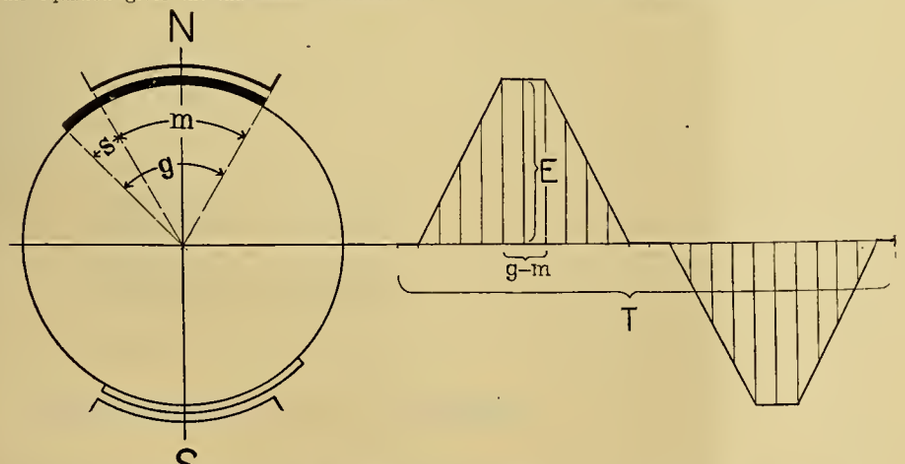


FIG. 3. DETERMINATION OF THE VIRTUAL ELECTROMOTIVE FORCE OF ALTERNATORS.

Determination of the Square Root of the Mean Square, or the Virtual Electromotive Force.

We have attempted to determine the theoretical value of the maximum electromotive force. This is, however, of less importance than the mean value, because on the latter depends the amount of work obtainable from the apparatus. This mean value, we will prove, is the square root of the mean square of all the variable electromotive forces, and is called "the virtual electromotive force."

A continuous current apparatus having a constant electromotive force will in a given period of time, accomplish an amount of work (Fig. 4):

$$E_1\,f_1\,t = a;$$

but

$$I_1 = \frac{E_1}{R}$$

Hence:

$$a = \frac{E_1^2}{R}\,t$$

where a denotes the amount of work, R the resistance, t the periods of time and E_1 the electromotive force.

In order to obtain the same amount of work from an alternating current apparatus in the same period of time, through the same resistance (free from self-induction), we have to find an equation that is equal to E and may be expressed in terms of e.

The work that the variable electromotive force and current acomplish (Fig. 5) in the time dx is accomplished by the equation:

$$da = iedx$$

where i is the variable current and e the variable electromotive force; but

$$i = \frac{e}{R};\ \text{therefore,}\ da = \frac{e^2}{R}\,dx,\ \text{and}\ a = \frac{1}{R}\int_o^t e^2\,dx.$$

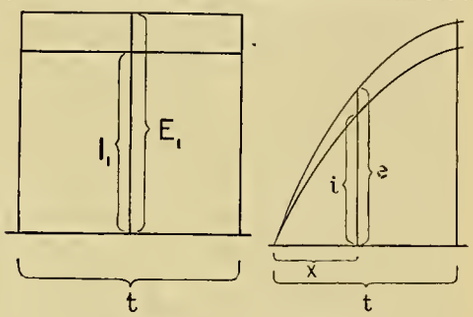
Substituting in equation for a we have:

$$\frac{E_1^2}{R}\,t = \frac{1}{R}\int_o^t e^2\,dx,$$

or:

$$E_1^2 = \frac{\int_o^t e^2\,dx}{t}.$$

$\int_o^t e^2dx$ designates also the sum of the squares of the electromotive forces over the axis of time from o to t.



FIGS. 4 AND 5. DETERMINATION OF THE VIRTUAL ELECTROMOTIVE FORCE OF ALTERNATORS.

We may say:

$$t = \int_o^t dx$$

or the sum of all ordinates, or electromotive forces from o to t, and we may write:

$$E_1^2 = \frac{\int_o^t e^2\,dx}{\int_o^t dx}.$$

E_1^2 is also equal to the square of all the ordinates divided by their number. E_1^2 is the square of the mean squares of the instantaneous values of e; or:

$$E_1 = \sqrt{\frac{\int_o^t e^2dx}{\int_o^t dx}}$$

which is the square root of the mean square, or the virtual electromotive force.

Spring-suspended Motor Patent Interference.

Patent applications of Walter Knight and Edmund C. Walker relating to the spring suspension of motors for railway cars are in interference in the Patent Office, Messrs. Knight and Morgan, the inventors, are backed, respectively, by the General Electric company and the Walker company, and the issue is considered one of much importance. On September 9th the examiner of interferences in the Patent Office decided in favor of Mr. Morgan as the prior inventor, and last week the case was argued before the Board of Appeal of the Patent Office by the late George R. Blodgett for the General Electric company and Frank T. Brown, of Brown & Darby, Chicago, for the Walker company. The decision was reserved.

It is rumored an electric light system will be established in Park River, N. D.

Magnetic Tests of Open Hearth Cast-steel.

Special attention has been given the subject of open hearth steel for electrical castings, by the Sargent company of Chicago, which furnishes the typical cases represented in the accompanying cuts.

A series of careful experiments, conducted by Prof. W. M. Stine at Armour Institute of Chicago, disclosed valuable information upon this subject. Two pairs of bars, rough turned to 11 inches by five-eighths inch, were submitted. The bars were marked as stated on the curves herewith presented. Both bars were accurately turned down and ground to a diameter of one-half inch. An end on each bar was ground off smooth and square. They were magnetized in the frame of a Hopkinson's divided bar permeameter. This consists of a heavy yoke of soft wrought-iron. The ends of the yoke were accurately drilled for a snug fit with a bar of one-half inch diameter. The test bars abut in the center of the longitudinal slot in the yoke. One test bar is clamped in place and the other is fitted with a handle for pulling the bars apart. Each bar carries a magnetizing coil, and over the joint is placed the test coil.

The magnetizing current was measured by an accurately calibrated ammeter, and the magnetic strength in the bars read off in terms of the deflection of a calibrated ballistic galvanometer. This was accomplished by pulling the bars apart about an inch and allowing the test coil to snap out and cut the lines of force. It is claimed that this method, when suitable apparatus is employed, is the most satisfactory one for determining the magnetic permeability of iron. It has two objections, however, namely, the three air-gaps introduce a slight error and the hysteresis area is slightly reduced by pulling the bars apart. For commercial purposes in general, both these errors are negligible.

The samples were run through five quarter cycles, comprising the magnetization from 0 to maximum in either direction.

The data for the first quarter cycle were platted for the magnetization curve. This is the curve upon which are based the calculations for dynamo fields and electro-magnets of constant polarity.

The curves submitted were platted in terms of centimeter measure. The strength of the magnetization is given in terms of H units; H per centimeter length of the magnetic circuit being 1.25 times the ampere-turns. The ordinates are expressed in terms of B units and represent the actual number of magnetic lines per square centimeter in the cross-section of the sample for the corresponding magnetization.

The permeability of the iron, denoted by the symbol H, is the ratio between the number of lines of force per square centimeter and the corresponding value of the magnetization in H units, or in general, B is H times H.

The hysteresis curve is of value in such cases where the metal is exposed to alternating magnetization. The residual magnetism in these samples is about 5,000 lines, while the magnetization needed to reduce the residual magnetism to zero is about two units.

If it is desirable to express the values of B and H in square-inch measure, multiply them by the factor 6.541; i. e., there are 6.451 square centimeters in one square inch. Thus, where B is 10,000 lines per square centimeter it is, for corresponding permeability, 64.51 lines per square inch.

The data for the hysteresis cycle state the actual results of the test for the quarters indicated. The data for the curves of magnetization are the readings for the first or ascending quarter cycle.

Hysteresis Cycle, Cast-steel Bar No. 1.

Lines per D. C. M. "B."	Magnetic force. "H."	Second Quarter. Lines per D. C. M. "B"	Magnetic force. "H."
17,000	58.4	400	2.5
16,650	44.5	7,150	5.57
15,600	25.8	13,200	12.79
15,100	19.2	14,400	19.25
14,200	12.78	15,150	26.2
12,750	5 57	16,500	44.5
9,800	2.5	17,000	58.4
5,000	00.00		
Third Quarter.		Fourth Quarter.	
16,650	44.2	450	2.5
15,600	25 8	7,150	5.57
15,150	19.2	13,220	12.79
14,175	12.78	14,400	19.25
12,780	5.57	15,200	26.2
9,800	2.5	16,500	44.45
5,000	0.00	17,000	58.4

Magnetization Curve, Bar No. 1.

Lines per D. C. M. "B."	Magnetic force. "H."	Permeability. "M."
5,000	2.5	2,000
10,200	5.57	1,860
13,650	12.79	1,064
14,700	19.45	755
15,400	26.15	590
16,500	44.5	372
17,000	58.4	296

Magnetization Curve, Bar No. 2.

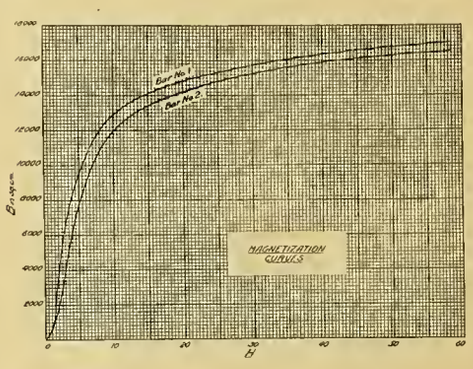
Lines per D. C. M. "B."	Magnetic force. "H."	Permeability. "M."
2,850	2.5	1,142
8,250	5.57	1,478
12,900	12.79	1,042
14,050	19.45	726
14,900	26 15	572
16,100	44 50	360
16,550	58.4	284

The Right of Injunction to Stop Railroad Construction on Sunday.

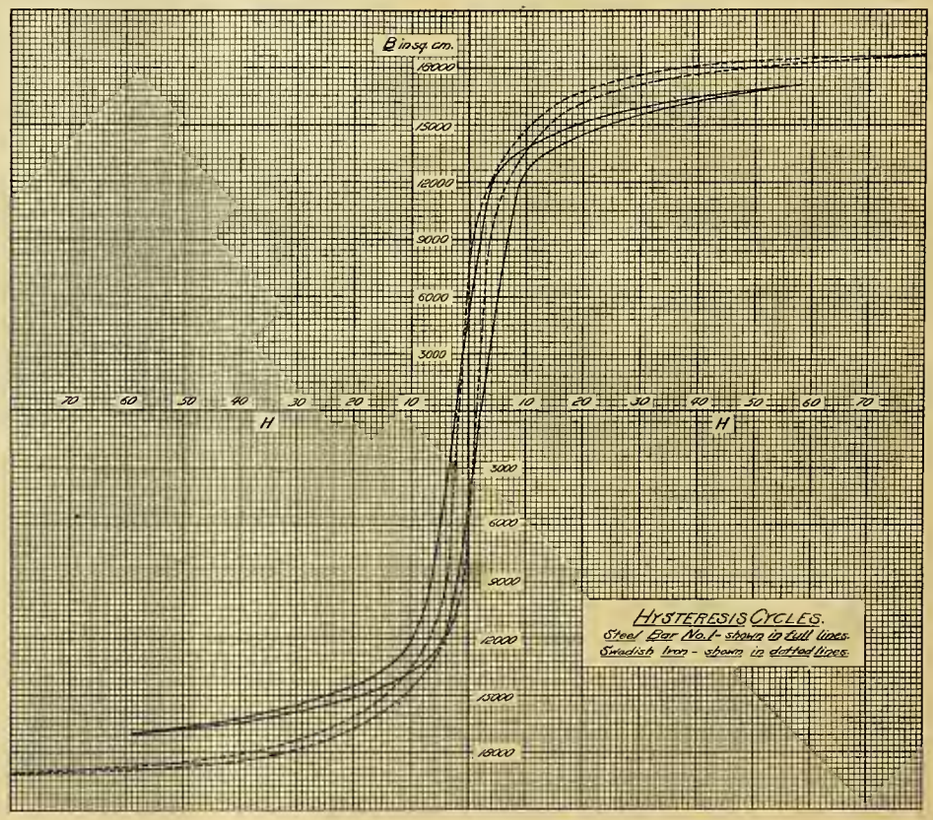
"Go away from home to learn the news," is the old saying. "Go to England to learn the law," might be a modern satirical version. For example, the Electrician of London solemnly assures its readers that "There is a curious law in the United States which permits of the construction of a railway unhampered by risk of an injunction, provided only that the work be done, and a car or train be run over the finished line, between midnight of Saturday and the same hour on Sunday." Such a law would be a curious one indeed, but nobody seems to know anything about it but the English journal quoted. In expounding American law, the writer seems to be his own statute-maker. However, it is true that the transformation of a few miles of ordinary road or street into the site of a completely equipped railway has been made more than once inside of the 24 hours succeeding midnight of Saturday. Moreover, that the custom probably leads to some of what the Electrician styles "jerry work" must also be admitted. But the fault is not in the law. It is that people are not so watchful on Sunday and that it is more difficult then than at any other time to find the proper persons to draw the necessary bill, grant, issue and serve the writ of injunction. The subject is one of considerable interest, and the Western Electrician has been at some pains to investigate it.

What appears to be the leading case on the subject, if not about the only one, is that of Langabier against the Fairbury, Pontiac and Northwestern Railroad company, 64 Illinois Reports, 243. The bill filed in this case alleged, among other things, that the company, immediately after 12 o'clock of the night of Saturday, with a large force of men, had taken violent possession of the street for the express and avowed purpose of finishing its track through its entire length before the next Monday morning, and that it had selected Sunday for the work for the purpose of evading an injunction and avoiding the process of court, etc. This bill was presented to a master in chancery, in the absence of the circuit judge, on Sunday. The writ of injunction was ordered by the master on that day, and issued by the clerk and served by the sheriff on the same day. At a subsequent term of the Circuit Court a motion was made to quash the writ, which was allowed and the bill dismissed. Appeal was then taken to the Supreme Court of Illinois, which reversed the decree of the court below, holding that it was error to dismiss the bill and that the Sunday issuance of the injunction was valid.

There is much in the decision which Mr. Justice Breese prepared for the Supreme Court in this case which is of general interest. He, or the Supreme Court of Illinois speaking through him, says that, as a general proposition, it may be conceded that Sunday is not a day in law for proceedings, contracts, etc. Anciently, however, courts of justice did sit on Sunday. The early Christians of the sixth century, and before, used all days alike for hearing of causes, not sparing the Sunday itself; but in the year 517 a canon was promulgated exempting Sundays. Other canons were adopted in subsequent years exempting other days, which were all revised and adopted by the Saxon kings, and all confirmed by William the Conqueror and Henry the Second, and in that way became a part of the common law of England. By the canons of the church Sunday was decreed dies non juridicus, and by the same canons other days were declared unjuridical, as the Day of the Purification of the Blessed Virgin Mary, the Feast of the Ascension, the Feast of St. John the Baptist, and All Saints' and All Souls' days.



MAGNETIC TESTS OF OPEN HEARTH CAST-STEEL.



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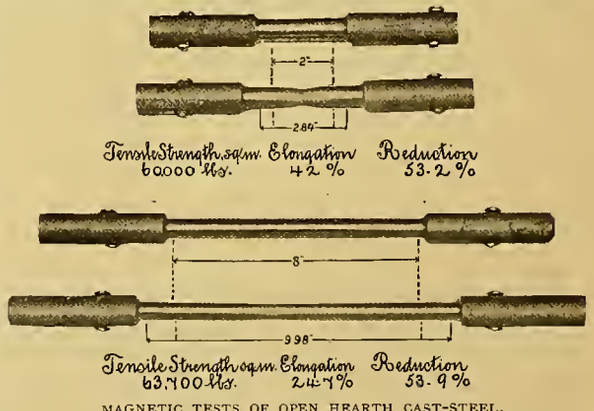


MAGNETIC TESTS OF OPEN HEARTH CAST-STEEL.

These were as much unjuridical as Sunday, yet the most devoted admirer of the common law would not hesitate to say that the proceedings of a court of justice in this state on either of those days would be valid. Why, then, if such an act can be done and have binding force on those unjuridical days

in this state, should not equal efficacy be accorded to the same act if done on the other unjuridical day, Sunday? It is answered that secular employment of any kind is prohibited by our criminal code. On a previous occasion the court construed that provision of the code as permitting acts of not only physical and absolute necessity, but work about which there is a moral fitness and propriety under the circumstances of each particular case.

The notion that Sunday is a day so sacred that no judicial act can be performed, continues this opinion, had its origin with ecclesiastics of an unenlightened age, and rests upon no substantial basis, and if it is the doctrine of the common law, it need not have application here, in this day of thought and increased enlightenment. Men are freer now than then, and are permitted to regard acts as innocent and harmless which were then deemed sacrilegious and worthy of anathema.

In the case under consideration this dies non juridicus was selected by the railway company as the proper day to commit a great outrage upon private and public rights, believing the arm of the law would not be extended on that day to arrest it in its high-handed and unlawful design. To the complainant the acts it was organized to perpetrate on that day were fraught with irreparable injury. Feeble, indeed, would be the judicial arm if it could not reach such miscreants. To save a debt of $20, judicial acts can be performed on Sunday, and maintained as well. To prevent the ruin of an individual, such an act must not be done. "Lame and impotent conclusion!" A court of chancery, as the maxim goes, is always open.

This case involved irreparable injury to property. An imperious necessity demanded the prompt interposition of chancery. On that principle the act was fully justified. This, in conclusion, it is said, is the dictate of right, of reason, of common justice and common sense.

The doctrine of this case is cited with approval in Richmond against Moore, 107 Illinois Reports, 429 (439). It is adopted as being established and of general application, in 24 American and English Encyclopædia of Law, 579; in 2 High on Injunctions (second edition), paragraph 1584; and in 1 Beach on Injunctions, paragraph 154.

It may be added that the above decision was rendered at the September term, 1872, and that, in the Act of 1874, to revise the law of Illinois in relation to injunction, the state Legislature especially provided that it shall be lawful for any officer who is authorized by the law of this state to grant writs of injunction, if it appears to him from the affidavit filed by the complainant, his agent or attorney, that the benefits of an injunction will be lost or endangered, or irremediable damage occasioned unless such writ be immediately issued, and if the complainant otherwise be entitled to such writ under the law, to grant a writ of injunction on a Sunday, and it shall be lawful for the clerk to issue, and for the sheriff or coroner to serve, such writ of injunction on a Sunday as on any other day, and all affidavits and bonds made and proceedings had in such case shall have the same force and effect as if made or had on any other day.

If tracks are once laid, or any other act done on Sunday, it will have the same effect as if accomplished on any other day, perhaps restricting the remedy to one for recovery of damages only, or making the legal battle one of such odds, with the aggressor once in possession, that prudence will counsel an abandonment of direct opposition.

Canadian Alderman's Views on Electric Power.

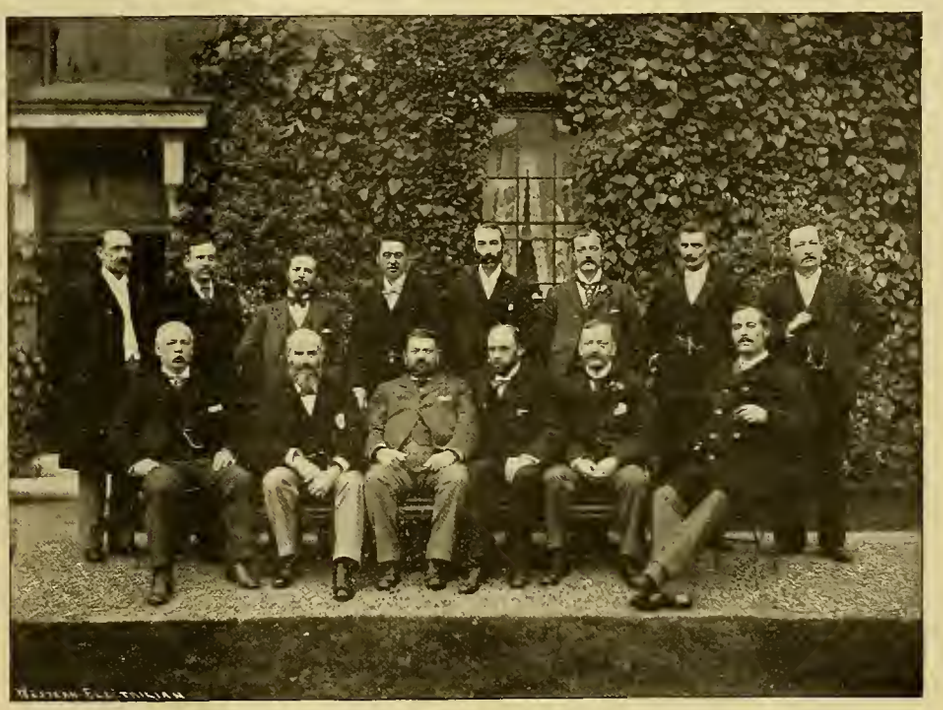
The question of securing cheap electrical energy has been agitating the minds of the officials of Toronto, Ont., for some time, and recently the Board of Control recommended that the council advertise until December 9th for proposals to furnish the city electric power, a forfeit of $30,000 to be posted and $100,000 to be spent on the development during the first two years. This recommendation the City Council rejected, and one objector asserted that there was no demand for electric power in Toronto. This was Alderman Spence, who expressed the opinion that electrical energy was a very expensive form of power, especially when it was used on a large scale and constantly. If electric energy was developed at the Humber it could not be brought to Toronto without great waste, he said, and the factories would be taken from the city to the Humber, thus injuring the city. The alderman delivered a learned dissertation upon power transmission, and he said that it was well known that scientific men were at present working upon the problem of long-distance transmission, the solution of which might mean that power could be brought from Niagara Falls or the Severn River to Toronto at a cheaper rate than it could be produced by coal. Where the demand did not exist the factories would not come for any cheapening of price. He cited the case of the Severn river, on the line of the Grand Trunk railway, where free power and exemption from taxation were offered to factories locating there, but despite these conditions factories did not appear. Factories are not crowding to Ottawa, notwithstanding its enormous power. It was not his intention or desire to deprecate the value of cheap power, but its value might be overestimated. He added that the running expenses of the proposed plant on the Humber river were to be $120,000, and that 12,000 horse power would be produced. This amount would be reduced one-half by loss in transmission, according to the engineer's statement. This would leave 6,000 horse power at a cost of $120,000. Running 300 days in a year this would mean 18,000,000 horse power hours, which would cost two-thirds of a cent or .66 of a cent for each horse power hour. He showed that the city was now producing power by steam at a cost of .60 of a cent per horse power hour, and that if an engine to produce 15,000 horse power were acquired it could produce power at .54 of a cent. The calculation on this point was as follows: Cost of 45 tons of coal at $2.50 per ton equals $112.50 per day, or $41,062.50 per year.

Varley Duplex Magnet in England.

The accompanying picture was taken at Derby, England. It shows in a group the stockholders of the Varley Duplex Magnet company (limited) immediately after the perfecting of their organization. Some of the leading men of the town, after a thorough examination of several months into the merits of the special machines, etc., which are used in the manufacture of the Varley duplex magnets, decided to form this company for the manufacture of duplex magnets and the various classes of work that can be produced by these special machines, working in harmony with the company in Jersey City. The English concern was capitalized for $50,000, fully paid up. The stock was over-subscribed by 40 per cent.

Location was obtained for a factory in Derby, where a full line of special machinery is being installed. A number of special machines are being constructed by the Varley Duplex Magnet company at Jersey City for the English factory. Everything that is manufactured in America in the line of magnets will be immediately reproduced by the concern at Derby, and it is expected that a saving in the cost of production will be effected. It is hoped that by January 1st the new factory will be in full operation.

The formation of this company was brought about by a visit to his native city by President Richard Varley, Jr., of the Varley Duplex Magnet company. Mr. Varley went to England in July, accompanied by Mrs. Varley, and his stay was prolonged by prominent men in that city becoming interested in his patented apparatus. He returned to New York on the Lucania, November 20th, and will at once push operations for the extension of the company's facilities in order to meet the large increase of trade. The address of the parent company is 138 Seventh street, Jersey City, N. J.



ENGLISH STOCKHOLDERS IN THE VARLEY DUPLEX MAGNET COMPANY.

Electric Coupling Device in Interference.

An interference in the Patent Office has been set up between J. F. McElroy, the engineer for the Consolidated Car Heating company of Albany, and W. E. Baker, the superintendent of the Metropolitan West Side elevated railway of Chicago. It relates to an electric coupling device for connecting, when necessary, the wiring systems of the cars of a train. Mr. Baker devised an appliance for use on the Metropolitan road and Mr. McElroy got up one that is employed on the Lake Street elevated road. Both gentlemen applied for patents, and the interference resulted. The examiner of interferences lately decided in favor of Mr. Baker, but an appeal will probably be taken. Brown & Darby are Mr. Baker's attorneys, and Ward & Cameron of Albany represent Mr. McElroy.

Telephone News from the Northwest.

[From the Mioneapolis correspoodent of the Western Electrician.]

The annual report of the Winnebago Telephone company of Forest City, Ia., shows the financial affairs of the company to be in good shape.

The Dell Rapids, S. D., Telephone company has been incorporated with $2,000 capital stock.

The Iowa Telephone company is arranging to establish an exchange in Albia, Ia., and another in Guthrie Center.

The Rocky Mountain Bell Telephone company will extend its system to Choteau, Mont., from Cascade.

The Western Telephone company is arranging to install a small exchange at Hamilton, Ia.

The committee for the independent telephone company of Mankato, Minn., has 200 subscribers in sight, and intends to make the number 300 to 400.

C. H. Billings contemplates a telephone exchange at Primghar, Ia.

The Jefferson Telephone company of Jefferson, Ia., has completed connection with Adaza, Jolly, Konoke and Fonda, Ia.

Work has begun on Rowe Bros.' telephone line from Pierre, S. D., to the Black Hills, and it is expected to have the line completed and in operation by March 1st.

No less than 25 free telephones of the Wisconsin Telephone company in Grand Rapids and Centralia, Wis., have been ordered out by the subscribers, who have been persuaded thus to do by the local company.

W. E. Forker wanted damages from the Mississippi Valley Telephone company at Burlington, Ia., for stringing wires in a private alley and over his house. A jury decided that no damages were due him.

Work has been begun on the toll-line system of the Wisconsin Valley Telephone company between Ashland and Hayward.

The Dakota Central Telephone company of Aberdeen, S. D., has connection with Ortonville, Minn., on the east, Huron, S. D., on the south, and Columbia on the north. Nearly all these lines were built this season.

The establishment of a long-distance telephone exchange in St. Paul was discussed by the Chamber of Commerce in that city, and it was resolved to recommend that a franchise for that purpose be granted to the American Telephone and Telegraph company of Minnesota by the council.

P. G. Reynolds, who spent a number of weeks in Texas, has returned to his office in Minneapolis. As superintendent of construction for the Southwestern Telephone company, he has had ample opportunity to see the progress in telephone building in the South. The telephone is used more in that section than in the Northwest. Cotton shippers insure their cargoes by telephone, and a large amount of other business transacted in the North by mail and telegraph is done there by telephone. Construction goes on all the year round. A new line is about to be built from Russellville to Van Buren, Ark., by this company, a distance of 94 miles. Mr. Reynolds says that in 10 days all construction work in the Northwest will cease, except that an extra circuit will be run from Faribault, Minn., to Minneapolis to take care of the extra amount of business.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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State of Illinois, County of Cook—ss:
Frank Foster Kenworthy being duly sworn deposes and says that he is a resident of the city of Chicago, in the county of Cook and state of Illinois, and that he is the superintendent of the binding department of the Electrician Publishing company, the publishers of the Western Electrician; that he was present at and superintended the binding of No. 21 of Vol. 20 of the Western Electrician, issued on June 12, 1897, and that there were sent out by actual count 20,000 complete copies of said Western Electrician of the volume and number above specified.
And further this affiant sayeth not.
FRANK FOSTER KENWORTHY.
Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

Four Years' Record of Electric Light Convention Advertising.

Issue	Number of Advertising Pages.	Whole Number of Pages.	Square Inches of Paid Advertising Matter.
March 3, 1894....	40	56	4,145
February 23, 1895.	52	68	5,593
May 9, 1896.....	72	88	7,576
June 12, 1897.....	80	100	8,643

No other electrical journal has ever equaled this record of 8,643 square inches of genuine full-paid advertising in a single issue.

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The chief of police of Omaha is an intelligent official. He has included pay-station telephone instruments in his order for the destruction of all slot machines found in the city. There will be no lack of supporters of his view that the dime-in-the-slot telephone is a game of chance, with very little show for the person contributing the dimes.

Prof. Koch, in Elektrotechnische Rundschau, recently described some very interesting experiments which seem to have a marked bearing on the conductivity of lightning rods.

He formed a chain several meters in length with links of iron oxide, and placed it in circuit with two accumulator cells and a galvanometer. This coherer was constructed in a room 30 meters from the galvanometer. When a spark was discharged in the vicinity of the chain the deviation of the galvanometer showed that the resistance of the circuit was reduced to one-thousandth of its normal value, and in a second experiment the resistance fell to one ten-thousandth of the normal.

Prof. Koch concludes from these experiments that they may afford an explanation why lightning-rods with poor conductivity are nevertheless effective in thunder-storms. The oscillations produced provoke an enormous reduction of resistance at the proper instant to facilitate the flow of current through the conductor.

In the discussion of a paper recently read before the British Institution of Electrical Engineers on the subject of accumulator traction, Mr. Manby described a new accumulator which has been used for the last few months on the Dresden tramways with considerable success. The special feature of this cell was the paste, which acquired a great degree of hardness. It had been subjected to very severe tests at Dresden, and had never cracked or broken up under them. The plates used at Dresden were 11 centimeters by 27 centimeters. There were 13 plates to each cell, which weighed 13½ kilogrammes. They worked at a discharge of 65 amperes, and on emergency up to 120 amperes without the slightest damage. On one occasion on the Dresden tramway line they had run for a whole working day over a distance of 130 miles without any charging. After seven months' trial the Dresden Tramway company was so satisfied with this type of cell that it decided to fit the whole of its cars with them. The normal discharge was one ampere for about 8½ square inches of positive plate, and a discharge of one ampere for 4.659 inches of positive plate was perfectly safe. Mr. Manby added that these facts had caused something of a sensation on the Continent.

Electrical manufacturers are particularly interested in the growth of the American export trade, and anything which our European competitors have to teach us should receive attention. There may be a hint in the example of the commercial association at Stettin, described by the British consul. This organization was established soon after the conclusion of the Franco-German war, for the purpose of extending and improving the maritime trade of the port and assisting it to compete with Hamburg and Bremen. The original members, at their first meeting in December, 1871, decided that the better education of clerks and young men who took up commerce as a profession was necessary. For this purpose evening classes were instituted, at which all branches of commercial education were taught. Further, young men were to be sent abroad to the British colonies, America and elsewhere to improve their knowledge of business and to work in the interests of Stettin trade. Each was to get $375 to cover traveling expenses and living for three months at the destination. This sum was a free gift; but repayment, when the recipient was able to do so, was treated as a matter of honor. Very few have failed to repay the money, the failures being mostly due to death. The German consul is advised of the student's arrival, and gives him assistance in carrying out the aim of his journey. Valuable reports on a great variety of commercial subjects have been sent in to the association by the students, and many of them have been printed and circulated among the members. Since 1872, 50 of these young men have been sent abroad to South and Central America, Singapore, Rangoon, Java, Hong Kong, the Transvaal, and other places, but mostly to the republics of Spanish America.

Again the lesson that efficient train dispatching and effective brakes are needed on electric as well as steam railways, for cross-country operation, is presented. It comes now from the bad electric railway accident which occurred near Detroit on Saturday last on the line of the Oakland Railway company between Pontiac and Birmingham, Mich. Two cars met in a head-on collision at the foot of a steep hill, and as a result five persons were killed and 14 injured. Among the killed are John Savage of Birmingham, the superintendent of the company, and the motorman on one of the cars. The other motorman escaped with his life but was injured. Both cars were wrecked, one telescoping the other for a distance of 12 feet. There is a steep grade on each side of the hollow in which the cars met, and the impact was terrific. The cause of this distressing accident seems to have been reckless running. A newspaper dispatch says: "According to the schedule a car leaves each end, Detroit and Pontiac, every hour, and there are three sidings along the road. To-day the cars were behind time. The one bound south for Detroit had passed an out-bound car at the switch two miles from Pontiac, the crew apparently being ignorant of the fact that another out-bound car was approaching them less than two miles distant, although it is claimed that they should have known it from orders sent from Birmingham. The weather was foggy and the rails slippery from the sleet which had formed upon them."

With a sigh of relief our English contemporaries announce the result of the investigation into the ancestral history of Michael Faraday. Dismay and consternation were plainly visible everywhere when the insinuation was made recently that the family of the famous scientist occupied a humble position in the lower walks of life. The "nice people" who had been admiring the genius of Faraday were horrified at the thought that among his progenitors was a common "day laborer." This impression is now corrected, and joy and gladness fill the hearts of the fraternity on the other side. A representative of the family, "Mr. John W. Faraday of Hayle, Cornwall," furnishes the information that "one Robert Faraday married Elizabeth Dean, the owner of Clapham Wood Hall, in Yorkshire. This hall, it is said, was of some beauty, and of a style peculiar to that part of the country; architecturally, it was very effective. Robert Faraday was the great scientist's grandfather, his own father, Barnabas, being born at the hall." It is explained that he was one of a large family, the members of which had to shift for themselves when they left the parental abode, but particularly emphatic is the statement that "in no instance was their condition in life anything approaching that of a 'day laborer,' a class of men whose position at that period was peculiarly miserable and degraded." Faraday's father was verger and sexton of the village church, leader of the choir, and a shoemaker by trade. Faraday's uncle was the owner of a neighboring quarry, and employed a number of "day laborers," and "was noted for his kindness to his employes." Faraday's father, James, formed an attachment to Margaret Hastwell, whose "father was a farmer, and also an employer of day laborers." He was averse to the match, being ambitious for his daughter to marry someone who had more cash than a youth who came from Clapham Wood Hall was likely to have. It is also said that James "followed the calling of a blacksmith," in London, and eventually married Margaret, and took her to London, where he had to fight his own battle, and, like many another, found it hard enough, Michael's earlier years are described as a struggle against poverty.

All of which is very interesting, but scarcely worth the fuss that has been made about it. However, it seems as if old-world prejudices must be consulted even when the recognition of genius of the highest order is involved.

Trolley Lighters for the Chicago River.

By Angus S. Hibbard.

For some years it has been apparent to marine engineers and even to casual observers that the Chicago River is unfitted to provide harbor and wharfage for the growing commerce of the city. The size of steamships and barges engaged in lake traffic has steadily increased, and to-day a landing is effected at elevators or coal docks far up the stream with the greatest difficulty. Drawbridges cross the stream at frequent intervals, being at some points so close together that when open they form a continuous line down its center, impeding not alone the marine but far more the land traffic, which waits, in long lines and blockades, the slow passing of some heavily laden craft. As a stream navigable for the purposes desired the river is not a success, and in its interference with the land traffic of a great city may be classed as a public nuisance. Recent agitation of the question of river and harbor improvement has taken the form of recommendations to dredge it out once more, this time to a depth of 21 or 26 feet. Opposed to this has come, from a competent source, the recommendation to make a harbor in the lake for all shipping along the 6,000 feet of frontage now available, and so provide amply for anchorage, dockage and wharfage of craft of any size. It was further recommended that the river be closed and covered and used from end to end as a boulevard. This plan was bitterly opposed, as tending to destroy the Lake Front Park and increase the congestion of traffic in the down-town district by the teaming of goods to and from the new lake docks. As a practical method of surmounting these objections, I have proposed a plan for preserving and increasing the utility of the Chicago river, which I will briefly outline.

I am in favor of an outside lake harbor for Chicago, with a breakwater or sea-wall extending preferably as far as the entrance to the Calumet River at South Chicago. I believe it to be inevitable that the grain, the coal and the greater part of the lumber shipped from and to this port must go to the Calumet River, where ample elevator and yard facilities may be had and where drawbridges interfere with the land travel of tens, or at most hundreds, instead of thousands of people.

Inside of the sea-wall docks and warehouses may be built to provide for the loading and unloading of freight, which may be transported to or from the docks along the Chicago river to any part of the city in lighters propelled by electric power. I should propose for the river traffic four lines of double trolley wires, two along the center and one along each dock. A broad, shallow lighter, say 100 feet long by 25 or 30 feet beam, with a screw wheel at each end and an electric motor at a point amidships, would provide ample carriage for freight of any description. It could attain a fair rate of speed in either direction, be steered from either end and, with the clean, noiseless and ample power provided, be made a handy boat for the purposes desired.

Such a lighter, loaded from a steamship or barge at anchor or from an outer dock, would first be towed to the entrance of the river. There connection would be made by the usual underrunning trolley, and power furnished to propel the boat at a fair rate of speed under bridges and to the desired dock. Here an overrunning contact and flexible cable would serve to carry the current until the boat was in place at the dock and tied up, when the cable could be pulled aboard. At the docks the motor could be used in various ways to furnish power to unload the boat, lifting package freight to the dock or onto trucks or hoisting it to upper floors of warehouses along the docks. In the same way lighters loaded at the docks would proceed to the river's mouth by electric power and there be towed alongside barges or steamships. Special lighters could be made to carry six or eight freight cars, thus carrying freight in carload lots either to the outer docks or vessels or to local docks in the city.

At the ends of streets abutting the river public docks could be established providing for handling freight to or from warehouses or mercantile establishments near by. By means of these and the trolley lighters, intramural transportation would be cheaply and readily effected. Coal delivered at yards in South Chicago could there be loaded on trolley lighters in wagon boxes, be transported by trolley to the docks nearest the point of delivery, and there, box and all, be hoisted to trucks and delivered with a minimum of teaming. In many other ways the river, on this plan, would be utilized and become a great water highway for the many instead of the few.

Ornamental, permanent bridges would cross at every street, serving for boulevards as well as for street railways, elevated railways and ordinary street traffic. The teaming in and through the business center would be reduced to a minimum, a result which would do much to secure clean streets. The bridge nuisance would disappear, and with it the puffing, noisy tugs and boats which do more to fill the air with smoke and grime than all other causes combined. From the lake park we should look out over a smooth sheet of water and, at a distance of half a mile or more, see rows of docks and warehouses, ships at wharves or at anchor, long lines of lighters being towed to and fro, and indeed the evidences of a busy commerce handled in orderly fashion, utilizing and conserving not alone the facilities in harbor and river afforded by nature, but availing of the advantages and economies to be secured from modern engineering. From an engineering standpoint it is certain that the results outlined can be accomplished. Are we to perpetuate the methods and the nuisances of the past or avail of the forces of to-day?

Central Station Work in Washington.

Brief mention was made last week in the Washington letter in the Western Electrician of the fire in the station of the United States Electric Lighting company of that city, but at the time the paragraph was written it was impossible to give accurate details of the damage done and the quick repair work that was accomplished.

The fire broke out about 2 a. m. on November 26th in the old station of the company at Fourteenth and B streets. It is believed to have been caused by a short-circuit in the wires in the outgoing circuits near the point where the cables leave the building. It was first discovered at the near-by switchboard, which was an old, wooden, boxed-in affair, and which seemed to burst into flames all at once. The switchboard, with all switches and instruments, was destroyed, and also 18 dynamo leads and 17 feeders leaving the board. The belts were burned off the machines, and also the wooden sheathing of the iron roof. The principal damage to the machinery was by water, and the loss is estimated as not exceeding $12,000, covered by insurance.

Frederick Sargent of Chicago, who is the consulting engineer for the company in the building of the new station, was in Washington at the time of the fire, and he was placed in charge of the emergency repair work. A new switchboard was rapidly put up. Instruments were secured from the General Electric company, and the local company was fortunate in having a stock of cables on hand. Two miles of cable of 500,000 circular mils area was needed to replace the burned-out wires. Other supplies were quickly obtained: the machines were dried out, and on the first night after the fire all the street arc lamps supplied from the station, about 700 in number, were operated. At the same time the alternating circuits had been rehabilitated and were carrying their full load, while arrangements were also made to supply light to the theaters. By the afternoon of Monday, the 29th, all customers were supplied as usual.

Within four months it is expected that the new station will be ready for use. This will be equipped with new machinery throughout, and is intended to supersede the old plant. It will contain four McIntosh & Seymour engines—two of 1,200 horse power each and two of 600 horse power each. Each of the larger engines is directly connected to two 400 kilowatt multipolar incandescent dynamos—one on each side of the engine—of General Electric make, and is also belted to a line shaft driving Brush multi-circuit arc dynamos. The smaller units—each consisting of a 600 horse power engine and two 200 kilowatt dynamos—are not belted to the line shaft. There are six Babcock & Wilcox boilers, each given a rating of 450 horse power, and they are equipped with Babcock & Wilcox automatic chain-grate stokers. Automatic coal-weighing apparatus is placed in front of each boiler. The stack is of iron, 200 feet high, and the plant includes a Green economizer. In the engine room there will be a Morgan overhead traveling crane, electrically operated, of 25 tons capacity. The Edison three-wire system of distribution will be used for the incandescent work. The entire plant will cost about $400,000, and it can be duplicated by tearing down a portion of the old plant, to which it is adjacent.

Electrical Measurement of Moisture of Soil.

Milton Whitney, chief of the Division of Soils of the Department of Agriculture, in his annual report to the secretary, says: "The electrical method of moisture determination has been still further perfected. Sixteen stations have been equipped with electrical instruments in various parts of the country, and in several important types of soil. Records have been kept at these stations for periods varying from two to four months, and it has been found that the method can be used by anyone with ordinary care. As a result of these field records, I feel perfectly satisfied with the operations of the method, and equally satisfied that it will prove of great value in soil investigations, as well as of practical and commercial value. One great value of the method is that the electrodes are permanently buried in the field at any depth desired, and the field can be cultivated or cropped as usual. The electrical resistance between the electrodes is read from a scale, and this resistance varies according to the square of the water contents. By once thoroughly standardizing the electrodes and by the use of tables furnished by the Division, the moisture contents of the soil can be determined at any time from the electrical resistance of the soil."

The council of Marion, Va., has granted a 15 year franchise for lighting that town by electricity. The town will take 175 incandescent lamps of 60 candle power each for street-lighting purposes.

Chicago Edison Company to Install Very Large Storage Battery.

One of the improvements now under way by the Chicago Edison company is the installation of a storage battery plant of remarkably large size. A contract with the Electric Storage Battery company of Philadelphia for this purpose was closed last week after a thorough investigation of the subject by President Insull and General Superintendent Ferguson. The plant will be placed in the basement of the Adams street building to take the peak of the down-town lighting and power load at the period of maximum demand. It will have a capacity of 22,400 ampere-hours at an eight-hour rate and 11,200 ampere-hours at a one-hour rate. The battery will consist of 166 cells, 83 on each side of the distribution system. There will be 87 plates in each cell, each 15½ by 32 inches. The installation will weigh about 500 tons and is to be in place by April 1, 1898. The cells will be so arranged that current from them can be taken at a potential of either 130 or 140 volts.

When in position this will be the largest single battery installation in the world. This statement is still more striking when it is considered that the plant will exceed the next largest by 43 per cent. in ampere-hour capacity and by 70 per cent. in watt capacity.

Telegraph and Telephone Business in New Zealand.

The annual report of R. J. Seddon, postmaster-general and electric telegraph commissioner of New Zealand, shows that for the year ended March 31, 1897, the government receipts from telegrams were £97,452 18s. 7d. and the miscellaneous telegraphic receipts £2,932 17s. 6d., while the revenue from telephone exchanges was £29,248 19s. 5d. The value of government telegrams sent was £23,118 2s. 6d. The number of forwarded telegrams was 2,520,169, an increase of 395,958. At the close of the fiscal year there were 6,284 miles of telegraph lines and 16,470 miles of wire. The number of telephone subscribers on March 31st was 5,747, connected with 29 exchanges. There is one "superintendent of electric lines," three telegraph inspectors, one sub-inspector, one electrician, 346 operators and 58 linemen. The telegraph and telephone business of the colony, as judged by the revenue, increased 2.55 per cent. over the preceding year, and the proportion of telegrams per head of population is 3.55. The telegraphic receipts were over £23,000 less than the expenditure, but, taking into account the value of government telegrams, a nearly even balance is figured. The operation of the government telephone service shows a loss since 1893. The loss for the year ended March 31st last amounted to £5,742 3s. 3d.

Chicago General Electric Railway.

Charles Austin Bates' effort to have a receiver appointed for the General Electric Railway company of Chicago has failed, but in other respects the decision of Judge Grosscup is rather in the nature of a victory for the complainant. The motion of Bates' attorney to the effect that the officers of the company shall produce the books of the corporation in court was granted, and the court ordered that the defendants appear before the judge or one of his masters, together with all the books and papers of the company, to testify respecting the issue of the cause. The order entered also enjoins the company from removing any of its books, papers or documents from the reach or jurisdiction of the court, and the clerk was ordered to issue subpœnas carrying out the court's order. Judge Grosscup, after rendering his decision, said, in answer to a question from one of the attorneys in the case, that during the pendency of the litigation any attempt on the part of the company to further dispose of bonds would no doubt bring about the immediate appointment of a receiver.

Ohio Brass Company's Trolley Business Sold Out.

As the result of negotiations that have been pending for some time, the General Electric company has purchased, at what is said to be a good figure, that part of the business of the Ohio Brass company of Mansfield, O., relating to the manufacture and sale of trolleys, or parts of trolleys, for electric railways. For a substantial consideration the Ohio company has entered into contract to desist from manufacturing trolleys and has transferred all its stock, good-will and business in the trolley-making line to the General Electric company. The contract has no bearing on other electrical devices made by the Ohio Brass company. Some time ago the General Electric company began suit against the Ohio company for infringement, under the broad Vandepoele patent, but when it became evident that that patent was not as impregnable as had been hoped the General Electric company adopted different tactics, with the result noted.

The contract for furnishing the Signal Office with 50 miles of galvanized iron telegraph wire has been awarded to John A. Roebling's Sons, Trenton, N. J., at 4¼ cents per pound, less 50 cents on each 100 pounds, making the price 3¾ cents per pound.

Electrical Machinery for the Manufacture of Armor Plate.

In accordance with the act of Congress, approved July 19, 1897, the Navy Department is inviting sealed proposals until January 29, 1898, for the construction by contract of a government armor factory, as a whole, in accordance with the plans and specifications. Proposals will also be received at the same time for furnishing separately the whole or any part of the machinery embraced in the plant. The following is the electrical equipment required: One electric charging machine; two 160-ton and two 75-ton electric overhead traveling cranes, with special hydraulic lifts; one 160-ton, one 100-ton, five 75-ton, one 50-ton, one 20-ton, and one five-ton electric overhead traveling cranes; three electric portable grinders; three direct-connected multipolar generators of 400 kilowatts capacity each, with engine complete; about 25 electric motors for operating tools of varying sizes; arc and incandescent lamps, and wiring for entire plant.

All bids must be accompanied by specifications and drawings, showing in detail the machinery proposed to be furnished. The department presumes that, should an appropriation be made by Congress for the erection of this plant, successful bidders will be required to enter into contract and give satisfactory bond in a penal sum for the performance thereof within the time specified in their proposals. The bidders will distinctly understand that no such appropriation has yet been made, and that not only is the usual right reserved by the department to reject any or all bids, but that, under the statute authorizing proposals, the department will report to Congress the receipt of all bids made, and await its further action. The time in which the work can be delivered or completed must be stated in the bid, and, in considering the bids, weight will be given to this statement, and also to any statement which bidders make as to the security which they will furnish for the faithful performance of any contract awarded to them.

Prospective bidders should apply in person to the recorder of the Armor Factory Board for information as to details, specifications and plans of such a plant, and for opportunity to examine and use the same in preparing their proposals. Proposals must be addressed to the secretary of the navy, Washington, D. C.

Arc Lamps for Photo-engravers.

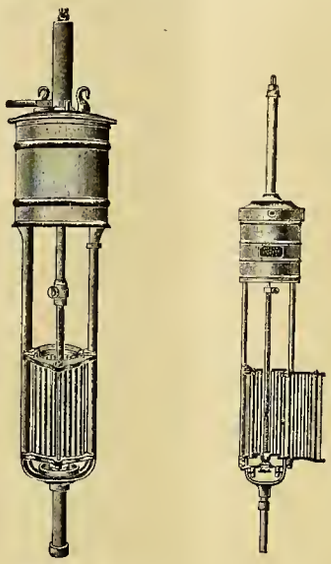
The Manhattan automatic focusing photo-engraving lamp manufactured by the Manhattan General Construction company, and which is here illustrated, is said to operate to the entire satisfaction of the users of such apparatus. The continued requests for a lamp of this description which have been made to the Manhattan company within the last three years, during which period the company

ARC LAMPS FOR PHOTO-ENGRAVERS.

had placed on the market 15,000 Manhattan arc lamps, made it apparent that a lamp constructed on substantial lines and to obtain proper results would meet a real demand. Such a lamp must be able to burn at any angle, give out steady light, without sputtering, and eliminate the spots and shadows so annoying in photo-engraving work. The Manhattan company accordingly went into the matter and has perfected the Manhattan photo-engraving lamp, which is recommended as designed to meet all the requirements for photographic and blue-print work. The lamp is portable, weighing but 40 pounds, and is constructed to operate singly or two in series on direct current 110 to 220 volt circuits.

Shadowless Arc Light Radiator.

The accompanying cuts show two arc lamps equipped with S.-W. arc light radiators, one open and the other closed, so as to show the method of attaching them. These radiators are made up of glass rods and are built in a frame of iron, and may be either plain, etched or colored. As compared with the common glass globe, they are practically indestructible. The light is more uniformly distributed over a greater area, while side shadows and those cast by flying insects are entirely done away with. The radiators are light in weight, easily attached and detached and can be cleaned without much trouble. They don't wear out and

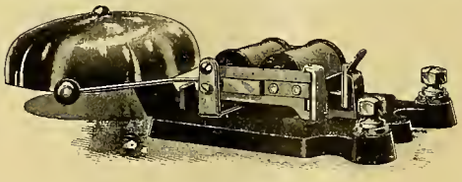


SHADOWLESS ARC LIGHT RADIATOR,

they are not easily broken, and it is also claimed that where used there is an appreciable saving of carbons. These radiators are made so that it is practically impossible for large bugs to get inside as in the old-style globes. The Shadowless Radiator Manufacturing company of Faribault, Minn., manufactures this radiator.

Marlo Iron-box Bell.

The manufacturer of the electric bell herewith illustrated, the Proctor-Raymond Manufacturing company, 444 Niagara street, Buffalo, claims that it cannot get out of adjustment. Important improvements in the contact post, armature and contact spring are claimed. The cover is made of cast-iron neatly japanned both inside and out, and firmly held in place by a German silver spring. The best ma-



MARLO IRON-BOX BELL.

terial and first-class workmanship are claimed, and each bell is in adjustment for one or two cells. Every bell is tested three times before being packed for shipment. It is said that where a contractor guarantees his work, the Marlo is the only safe bell to use, as it will save its cost several times over in labor on repairs before the guarantee expires.

Street-car Lamp.

The important feature in lamps intended for use on railway circuits is long life without decrease in brilliancy. To secure this both mechanical strength and uniformity of product are essential. Railway lamps should be uniform not only in size, shape and appearance, but absolutely so in current consumption. Both length of life and sustained candle power depend upon such uniformity, and while the former is the most desirable characteristic, it should not be forgotten that lamps are primarily made to give light. Practically, any length of life can be secured in lamps of low efficiency—lamps consuming a large amount of power; but power is not had for nothing, and while one lamp may last longer than another, it may consume so much current as to make it cost more than a lamp of shorter life consuming less current. Furthermore, a lamp may have a very long life, and yet be so dim as to make it worthless—consuming current without giving a proper return in life. The ideal lamp, therefore, is that in which the average life is combined with average candle power and energy consumed to give the best lighting service for the least cost, including lamp renewals and power consumed.

In the Edison railway incandescent lamp the desirable results are obtained, first, by its mechanical strength, the filament, of cellulose with a hard graphitic carbon coating, being so shaped and anchored as to protect it, as well as the bulb, from injuries likely to occur from the vibration and shock inseparable from street-car service. The anchoring of the filament is essential. An unanchored filament must necessarily be so stiff and short as to limit the light to a small area. This reduces both the efficiency and sustained brilliancy of the lamp. The position of the anchor is also of importance. To anchor the lower end of the filament to the inside of the bulb is objectionable. The filament is held too rigidly, exposing both it and the anchor to rupture in case of jar or shock. Rigidity can be eliminated by loosely resting the filament in the loop of the anchor, but the friction of the filament in the loop quickly wears it away. In the Edison lamp the anchor is set in the stem and the vibration of the filament is rather checked than entirely prevented. It is thus not strained or weakened, as both filament and anchor vibrate together, and no chance exists of the branches interlocking and short-circuiting, as would probably be the case if one loop of the filament were anchored to the side of the bulb and the other left free to vibrate and strike against it.

As railway lamps are operated in series, the current capacity should be uniform. Edison railway lamps are, therefore, made in three different clases—for 500 volt circuits, for 550 volt circuits and for 600 volt circuits—in each class the lamp being selected for a given amperage. The standard railway lamps have an efficiency of four watts per candle at full 16 candle power. They are fitted with the standard Edison screw base, or with bases to fit almost any make of socket. The lamp is made in the standard pear shape, but for the decoration of cars or for headlights, or special locations in which a small, compact bulb is required, the round-bulb lamp is manufactured. Its filament is shaped and anchored as in the standard railway lamp, and both are furnished frosted or of almost any desired color—either artificially dipped or in natural glass. The

STREET-CAR LAMP.

cut shows the exact size and shape of the round-bulb lamp.

The best lamp can be so misused as to render it worthless, while by proper use the maximum of life and light is obtained. Proper use demands that the same amperage and make in lamps be used on the same car or series; that they be ordered to suit the total voltage of the circuit, and that the lamps which have become dim from age be at once replaced by new ones. And this last requirement is necessary if light is to be economically produced.

Three Big Railway Deals.

Representatives of a syndicate of Baltimore, London, New York, Philadelphia and Pittsburg capitalists have purchased all the stock of the United Traction company of Pittsburg, amounting to $20,000,000, of which $3,000,000 is preferred and $17,000,000 common. This will give them control of the largest street railway system in Pittsburg and Allegheny, owning and operating 117 miles of electric lines. The United Traction company is a consolidation, effected about July 1st, of all the lines formerly owned and operated by the Second Avenue Traction company, running through some of the principal streets of Pittsburg and connecting that city with several suburbs. It controls the only access by street railway to Pittsburg on both sides of the river from the valley of the Monongahela. The consolidation also included all the lines formerly owned and operated by the Pittsburg, Allegheny and Manchester Traction company and the Federal Street and Pleasant Valley Passenger Railway com-

pany, comprising practically all the lines in the city of Allegheny. The earnings of the United Traction company for the months of July, August, September and October amounted to $501,129.78. The operating expenses, including taxes and insurance, were $248,538.29, leaving net earnings of $252,757.49. The fixed charges for the same time were $166,433.34, leaving a surplus of $86,325.15.

It is announced that the Union Traction company of Philadelphia has secured control of the Hestonville, Mantua and Fairmount Railway company, although the officials of the Traction company say that it was purely a transaction of individuals, and that the company is not directly concerned. As a result, it is said that the two companies will henceforth be operated in harmony, and the opinion is general that the Hestonville will actually pass into the control of the Union Traction. The Union Traction company for several years has controlled all the street railway lines of Philadelphia with the exception of those of the Hestonville company. The latter operates 24 miles of track, and last year carried about 11,000,000 passengers, with gross receipts of about $600,000. The transaction was private, and the price was not made public, but the announcement of the deal on the Philadelphia Stock Exchange was followed by a rise in Hestonville of $1 a share to 50, and Union advanced one-half to 12½.

That Washington and Baltimore will be joined by a railway system operated by electricity at an early date seems now to be a fact. The majority interest in the Maryland and Columbia railway has been purchased by a syndicate through the Baltimore Security and Trading company. The deal has been pending for some time, and the announcement is now made that it has been consummated. The purchase carries with it the control of the Eckington and Soldiers' Home and the Belt line of Washington and the Catonsville Short line, and the Ellicott City line of Baltimore. The price stated as having been paid for a controlling interest in the roads is $450,000. Among the purchasers are named John E. Searles of New York; H. P. Scott, Wilmington; Henry A. Parr, Thomas J. Hayward and Edward L. Bartlett of Baltimore, and Charles A. Lieb of New York. The purchaser named in the record is the Baltimore Security and Trading company, the officers of which are: Nicholas P. Bond, president; Francis A. Carey, secretary, and David M. Newbold, treasurer, who, with O. T. Crosby of Washington and Robert S. Carswell of Baltimore, compose the board of directors of the company. By the consummation of the deal some well-known men who were interested in the road have been retired. These include W. L. Elkins, P. A. B. Widener, Thomas Dolan, S. F. Tyler and George A. Huhn of Philadelphia, T. Edward Hambleton, Thomas M. Lanahan and B. N. Baker of Baltimore. The plant includes one of the best constructed roadbeds for street railway purposes in the country.

Bossert Steel Boxes for Electrical Wiring.

No electrical specialty has been placed on the market for several years which promises to have so extended an introduction into construction work as the steel outlet and switch boxes described below. They are the natural outgrowth of the demand of insurance men for the use of better material and safer methods in all electric lighting work, and they are such an improvement over cast-iron boxes that it seems to be only a question of time before the cast-iron box will have disappeared entirely from all wiring installations.

The steel boxes are light, indestructible, neat in appearance, and, it is stated, can be produced cheaper than the cheapest cast box. Moreover, there is no trouble due to inequalities of shrinkage, as every steel box is the same.

Two different styles of outlet boxes are used by contractors at the present time: First, the lined cast-iron box with holes drilled and tapped in sides for insulated nipples; second, the unlined cast split boxes with seven or more untapped openings in sides for inserting the conduit, the extra holes being in some cases closed by small metal disks. The first style is evidently the better, because a continuous water-tight passage for the wires is formed by coupling up the nipples and the conduit; but it is considered too expensive for general use. The second style possesses only one point of merit—its cheapness. Those who have used boxes of this class testify that they are about as water-tight and fireproof as a soap box.

In order to meet the demand for either of the styles mentioned, the manufacturers are placing on the market two kinds of steel boxes, one to be screwed on conduit, the other to have the conduit laid in openings in the sides. Fig. 1 shows the first style, Figs. 2 and 3 the second. Fig. 1 gives an ideal arrangement where an air-tight, water-tight and fireproof construction is desired. Figs. 2 and 3 show the other style, in which the conduit is inserted without screwing in. In Fig. 2 the holes are plugged with a steel plug after being punched. These plugs are inserted by machinery, and when in position close the holes completely. They can be removed at pleasure with a few sharp blows of a hammer. The holes are made the exact outside diameter of the pipe, insuring a fairly good water-tight joint. In cast-iron boxes a good fit cannot be had, because of unequal shrinkage, which necessitates the holes being left somewhat larger than the conduit.

Fig. 3 is a split box which recommends itself because of the ease with which it can be placed in position, particularly if it is used as a combination fixture box, and it is desired to run through it a gas pipe which is already up. This box is furnished with all the openings closed by metal disks, which can easily be removed wherever desired.

In Fig. 4 is shown a box with fixture stem inside for electric fixture, and in Figs. 5 and 6 a box for combination gas and electric fixture. The gas pipe passes through the steel tube in the center of the box and the tube is made slightly longer than the box is deep, in order to shed any moisture which may collect at the back of the box and run down the gas pipe.

Fig. 7 shows a switch box for push-button switches and plug receptacles. It possesses an ingenious feature in the way of an adjustable cover which allows the switch plate to be set perpendicularly independent of the box, the entire cover swinging around the center by means of the elongated screw-holes shown. This is a simple feature which has been widely appreciated.

Fig 8 shows a smaller box intended for flush switches. It is very light and just small enough to give the flush plate a little lap on all sides. This promises to be a very popular box.

A box for two flush switches is shown in Fig. 9. This also has the adjustable cover previously referred to, and is so arranged as to do away with the necessity of a back plate, which always adds considerably to the expense of gang switches.

All the round and square boxes are made in two styles, either with or without the threaded lugs and with the outlets plugged or open as ordered. Covers are also furnished in different styles, depending upon the use to which the box is put. The fixture box has a cover with large hole in center to go around the fixture, and two small bushed openings, one on each side the central hole, for the passage of the cord or fixture wire. Other covers have one bushed opening in center for fixture cord, and still others are made solid.

The Bossert Electric Construction company manufactures these boxes under the patents of the president of the company, W. F. Bossert, a gentleman who has been in the electrical business for many years. The company is at present taking aggressive means of placing these boxes on the mar-

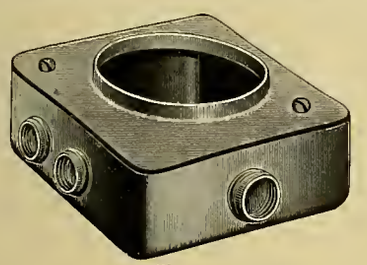


Fig. 1.

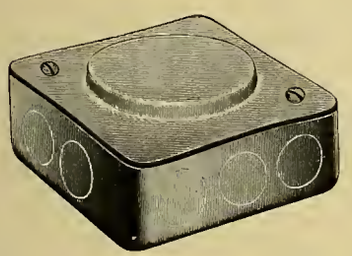


Fig. 2.

Fig. 7.

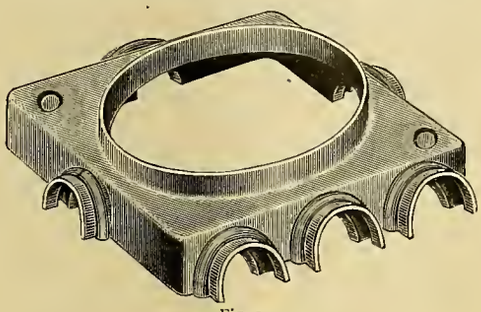


Fig. 3.

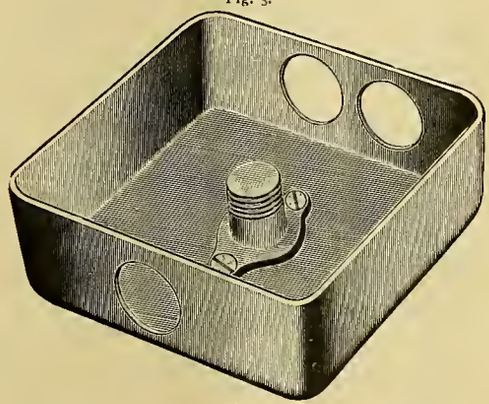


Fig. 4.

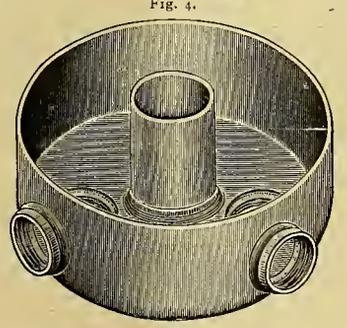


Fig. 5.

BOSSERT STEEL BOXES FOR ELECTRICAL WIRING.

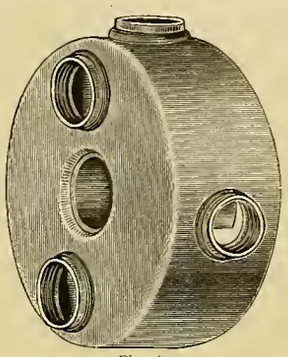


Fig. 6.

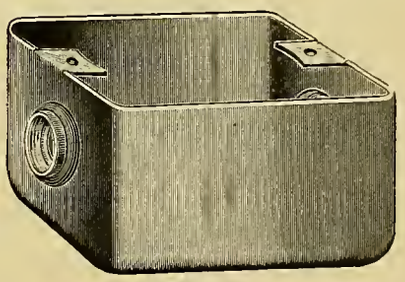


Fig. 8.

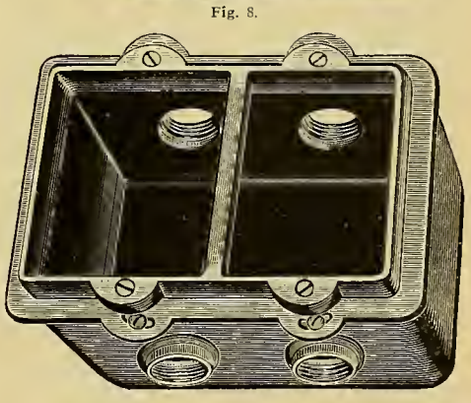


Fig. 9.

ket, feeling sure that they only need to be known to be appreciated. It has just issued a handsome catalogue, which is probably the most complete catalogue of outlet boxes ever published, 1,200 different boxes being listed. The factory is in Utica, N. Y.

Commercial Travelers' Fair.

Flattering reports are received from Alfred Chasseaud concerning the coming Commercial Travelers' Fair, which is to be held February 28th to March 5th at Madison Square Garden. Mr. Chasseaud is the general manager. The fair, in just the measure that it proves successful financially, will help to complete the partly built national home for disabled commercial travelers and their dependent families and the widows and orphans of commercial travelers. The incomplete building stands on South Mountain, near the city of Binghamton, N. Y. The Commercial Travelers' association recently held a convention at Binghamton and unanimously voted to assist the fair. Mr. Chasseaud was appointed to manage the fair, and all the travelers agreed to back him up. The officers of the Commercial Trevelers' Fair are: President, Chauncey M. Depew; vice-presidents, Governor Frank S. Black and Mayor William L. Strong of New York; secretary, R. G. Dun of New York, and treasurer, Mayor George E. Green of Binghamton. Mrs. T. C. Platt is the chairman of the women's committee, and Van Schaick & Norton are the counsel. Travelers in many parts of the country are sending in to Manager Chasseaud pledges of cash New Year's gifts, and in hotels everywhere are being placed glass collection boxes in the shape of miniature travelers' trunks. The Buffalo Hotel Men's association has just pledged its hearty support to the fair and other hotel organizations will aid.

Evils of Public Ownership.

[From Leslie's Weekly.]

There is much talk nowadays of public ownership of everything, from gas and water to street cars, telegraphs and telephones. In theory this is no doubt very pretty, but in practice we have an idea that, under present conditions, at least, it would prove to be expensive and even dangerous.

If our municipal corporations were as well managed as they should be, if the political machines were already as effectually smashed as in good time they will be, then the public ownership of all these semi-public properties might be very well indeed. But at present we have much more property publicly administered than can be looked after with either economy or skill.

As a general thing the streets in American cities are badly paved, badly drained and badly cleaned. On the other hand, the street cars, the street lights and the telephones—all generally under private management—are usually very good.

Whenever we hear an argument for public ownership we are usually told to look at the English example of the effective working of the telegraphs and telephones by the Postoffice Department. But even in England they put up jobs on the best postoffice department in the world, and private owners secure from the public the most profitable privileges that are to be had. In 1892 Sir James Fergusson was postmaster-general of Great Britain and made a contract with the National Telephone company, turning over to that corporation the very profitable business of the local telephone exchanges in the great cities and leaving to the Postoffice Department the operation and maintenance of the expensive trunk lines between the different towns. In 1897, when the Duke of Norfolk has become postmaster-general, Sir James Fergusson is the director of the National Telephone company. So, even in England, we see that there are grave dangers that jobs may be put through to the injury of the public and the profit of monopolists.

In this country the general government and the municipalities as well have bitten off quite as much as they can comfortably masticate.

CORRESPONDENCE.

New York Notes.

New York, December 7.—It looks now as though the dispute between the electrical contractors and the Brotherhood of Electrical Workers might be settled without a strike. The question at issue is one of wages, the men demanding $4 for a day of eight hours, instead of $3, which they are now receiving. A conference has been arranged to consider the matter, and a satisfactory outcome is hoped for. The demands are directed against the Electrical Contractors' association, composed of 25 of the principal electrical construction firms in the city. There are about 1,000 men in the electrical workers' organization, and it is feared that if the strike does come the men of other building trades will become involved in it. The conference was arranged by the executive committee of the United Building Trades, of which the Electrical Contractors' association forms a part, and that committee has practically arranged for a conference with the workers. George O. Jenney, chairman of the conference committee and delegate of the Brotherhood of Electrical Workers, said yesterday that there were some details still to be arranged, but that such a conference would be held, and that it looked as if there would be a satisfactory settlement within a few days. He is confident that the $4 scale will be accepted by the contractors. On the other hand, come concessions of importance may be made by the workers. Mr. Jenney said: "The present scale has been in force for seven or eight years, without any change, except that on May 15, 1895, the hours of labor were reduced to eight, the wages remaining at $3 a day. We feel that we ought to receive at least as much as, if not more than, is paid to other workers in the building trades, because considerable technical knowledge is required of electrical workers, and they have to fit themselves for their work by diligent study. The steamfitters and plumbers receive $3.75 a day; carpenters, $3.50: stonecutters, masons and bricklayers, from $4 to $5. The brotherhood has a board of three expert electricians, which examines every man who applies for a union card, and so thorough is this test that the card is accepted by employers as a certificate that the man is qualified for work in the line specified on the card, whether it be fixture, bell or dynamo work or general wiring. There is such activity in the trade that every electrical worker in the district is employed, and some firms have advertised for men to enable them to carry out their contracts. To meet this need the examining board held an examination of nearly 100 men on Friday, and will hold two more examinations this week. The members of the brotherhood do practically all the electrical construction and repair work in New York and within a radius of 25 miles. There are few non-union men, and about the only work not done by the brotherhood is that of the small contractors who do their own work with the occasional assistance of a helper or an apprentice."

The Kings County Electric Light and Power company, recently organized in Brooklyn by well-known capitalists to compete with the Edison Electric Illuminating company of Brooklyn, is pushing forward its work with rapidity. The last of the four cash installments of the $5,000,000 in which the company has been capitalized will be paid in on December 20th. The contract for the ironwork of the station at Gold street and the East River was let on Wednesday. The work is to be done in three months. The building complete will cost about $350,000, and it is said that the company will have spent, when its plant is ready for business, about $2,500,000. There are down already 20 miles of heavy mains, and Fulton street, Myrtle avenue and Flatbush avenue are torn up at present by the employes of the company. The practical head of the company is A. M. Young of Waterbury, Conn. Mr. Young has set up many electric light plants, and this one is his largest and most important undertaking. It is stated that the plant will have a capacity of from 25,000 to 30,000 horse power, and it is the intention of the company to make its power house the most complete of any in the United States. The Brooklyn men interested in the new company include William Berri, Felix Campbell and Seth L. Keeney. Besides these, Vice-president Garret A. Hobart, ex-Governor Roswell P. Flower, Anthony N. Brady, Mr. Barbour, the thread manufacturer of Paterson, and others, are heavy stockholders. While the promoters and stockholders of the new company are reticent as to their plans, it is known that they expect to get a good deal of the Edison company's business. The probability of extending the operations of the company to Manhattan Island are quietly discussed, and it is altogether probable that early plans will be made to cover the desirable thoroughfares of the suburban territory in the city of New York on Long Island. The new company has received an advantageous offer from both the elevated railroad companies, it is said, to furnish motive power for the roads, but the offer is not likely to be accepted. It is hoped to have the plant ready to run by March 1st.

At the convention of the American Society of Mechanical Engineers in this city last week these officers were elected: President, Charles Wallace Hunt, New York; vice-presidents, E. S. Cramp, Philadelphia; S. T. Wellman, Cleveland; J. F. Durfee, New York; John C. Kafer, New York; David R. Fraser, Chicago, and Walter S. Russell, Detroit; managers, Norman C. Stiles, Watertown, N. Y.; E. D. Meier, St. Louis; George W. Dickie, San Francisco; H. S. Haines, Atlanta, Ga.; Gustavus C. Henning, New York; A. Wells Robinson, Milwaukee; James B. Stanwood, Cincinnati; Henry H. Suplee, Philadelphia, and George Richmond, New York; treasurer, Major William H. Wiley, New York. Among the papers read were: "Multiple-cylinder Engines: Effects of Variation of Proportions and Variable Loads," by R. H. Thurston; "Notes on Rating Electric Power Plants on the Heat-unit Standard," by W. S. Aldrich; "Electricity in Cotton Mills," by W. B. Smith Whaley of Columbia, S. C., and "Thermodynamics Without the Calculus," by George Richmond of New York.

M. S.

New England News.

Boston, December 7.—It is stated that during the last 12 months of its operation the West End Street Railway company has carried 200,000,000 passengers, as against 137,028,449 in 1894, 155,231,506 in 1895, and 166,862,228 in 1896. This is said to surpass all similar totals for a year in any other city in the world in proportion to population, and from these figures it is argued that the local transportation problem is a long way from solution, and will soon demand earnest consideration. For the past 10 years and more this question has been troubling the citizens of "Greater Boston," so called, and it is claimed in certain quarters that the question of local transit is as much an open one to-day as it was before the subway was started or the scheme of building an elevated road was conceived. When the whole line of the Boston subway is in operation it is estimated that 33,000,000 passengers will annually avail themselves of its benefits. It is further claimed that one-half of this number will be made up of residents of cities and towns outside of Boston. What the above gain in traffic represents may best be judged by taking into account that in 1877 the number of passengers carried by all of the street railroads now controlled by the West End was less than 50,000,000. In 1887 the number had increased to over 90,000,000. It is said that no other city in the world can approach these figures, population considered.

President Samuel Little of the West End placed one of his handsome parlor cars at the disposal of President Ingalls of the Big Four and the Chicago park commissioners who visited Boston recently. A run was made through the suburban districts, and the visitors were profuse in their complimentary allusions to the city's beautiful and extensive open-air resorts.

A bill for $2,714.61 has been sent to the West End Street Railroad company by the Rapid Transit Commission for the rent for the part of the subway used by the company from September 1st to October 1st. The commission has estimated this rent on the basis of 4% per cent. per annum on the cost of construction, which for the present purpose is figured at $668,211.53 for sections 1, 2 and 3.

Sixty members of the Electric Club partook of the autumn banquet held at the United States Hotel last month. The guests of the club were M. J. O'Leary, secretary of the Telegraphers' Mutual Benefit association of New York; Charles C. Bruch, assistant secretary of the Postal Telegraph company of New York, and W. W. Neifert of Nantucket. There was a long and varied musical programme. The speakers of the evening were John D. Mulloney, who told of the hardships and privations endured by Prof. Samuel F. B. Morse, while perfecting the telegraph, Joseph W. Larish, Charles E. Bagley and the guests of the evening.

The Massachusetts Editor, a new monthly paper which has been adopted as the official organ of the different press associations in the state, has the following note in reference to the Bell Telephone company in its latest issue: "It makes the editors of New England ache to realize the prices charged by the New England Telephone company for the rent of telephones when he knows that in the middle and western states splendid local telephone service is offered profitably at one-quarter the prices paid here. Isn't it high time for the newspaper editors of this section to talk and work against these exorbitant charges? If the New England editors should combine in an assault upon these excessive rates the day of cheaper and fairer prices would soon dawn. No class of business men suffer from these exorbitant charges more than publishers, because a telephone is well-nigh a necessity in a newspaper office. To illustrate into what straits the Bell monopoly is driven, where competition has grown strong, it is stated as a fact that in some middle-west cities its telephone service has been offered free in order to combat the competing companies. Editors should not, in all fairness and justice, longer remain quiet under these unjust, unfair, exorbitant fees."

Franchises have been granted for the construction of electric street railroads in Walpole and Foxboro, Needham and Milton. The last-named place is an aristocratic suburb of Boston, and, until very recently, projects contemplating the building of an electric car line through the streets had always been defeated. The street railway supporters won at a special town meeting on October 26th, and now the selectmen are giving hearings in regard to the location. Another electric road is in process of construction from Marshfield station, the home of Daniel Webster, to Brant Rock, a summer resort situated in the same town. The line will then go to Duxbury Beach, a distance of five miles, and will be completed for the summer travel next year.

The first electric railroad in Vermont, north or east of Burlington, is rapidly nearing completion. It extends from Waterbury, a town on the Vermont Central railroad, to Stowe, a mountain inland town eight miles south of Morrisville. The new road will enable Stowe to have connections with other parts of the state by rail, traffic being now carried on over rough wagon roads, which are practically impassable several months in the year. The new line will be 10 miles in length and will carry both passengers and freight. The rails are heavier than those ordinarily used on electric roads, and freight cars from steam roads will be carried over them.

The American Street Railway association having decided to hold its convention of 1898 in Boston, it can be prophesied that the members will be given a taste of genuine old-fashioned New England hospitality. Already steps are being taken to make the event the most interesting and memorable in the history of the organization. In addition to

the business of the meeting, it is proposed to have one of the finest exhibitions of electrical appliances in the field of street railway transportation possible to assemble, and it is expected that the demand for space will be so great that it will be necessary to lease the whole of Mechanics' building. If this is done, it is proposed to continue the exhibit until the association opens its regular fair season, and make it a part of the regular display of the Mechanics' Charitable association. The American Street Railway association had its birth in this city. Here was held its first gathering, and from the small beginning one of the largest and most important combinations of practical railway men has grown. It is, therefore, fitting that the city should give a royal welcome to the members.

The meeting of the National Academy of Science brought to this city a distinguished company. Almost every one of the professors and other men of note who made up the gathering ranks as a noted expert in his line. Among those who contributed papers were Prof. Charles R. Cross, head of the electrical department of the Massachusetts Institute of Technology; Prof. Charles Sedgwick Minot of the Harvard Medical School; Prof. Trowbridge of Harvard, who lectured Wednesday evening on the effects of electricity from a large battery of 10,000 elements, lately made by him; Prof. Michaelson of Chicago; Prof. Hyatt of the Natural History Museum, who gave a contribution on geology; Prof. Ira Remsen, who read a chemical paper, and Prof. Rogers of Maine, who discussed the value of the old standards of measure. At the second day's session of the Academy a matter of unusual interest came before the body. Miss Alice L. Gould, daughter of the late Benjamin Apthorp Gould, who was a member of the Academy, presented to the organization a fund of $20,000, for which the Academy selected trustees. This is to be known as the Alice L. Gould fund, to distinguish it from the generous gift made to the Academy by the deceased astronomer, and the proceeds of the fund are to be used at the discretion of the trustees in furthering astronomical and mathematical research.

At a joint convention of the city government of Auburn, Me., on November 15th, the first step was taken which probably makes certain that during the coming season an electric road will be built to Turner, which will be a link in the electric road project being engineered by the wealthy syndicate composed of Amos F. Gerald of Fairfield, the Hon I. C. Libby of Waterville, the Hon. H. Fritz Twitchell and Hon. Galen C. Moses of Bath and Hon. Herbert M. Heath of Augusta. At the meeting an order was introduced authorizing the location and construction of the line from the terminus of the Lewiston and Auburn electric road in Auburn to Turner. This will no doubt have a unanimous passage. In the spring the road will probably be built from Lewiston to Brunswick and Bath, with branches to Small Point and other places. The plan is also understood to include an extension to Portland, which will eventually connect with a network of roads which will extend into Massachusetts.

Only the finishing touches on the magnificent electric light and heating plant of the Boston city hospital remain to be made. Henry F. Cottle, chief of the electrical construction division of the Public Buildings Department, places the cost at about $65,000. It was a little more than a year ago that the work was commenced, and the plant, it is held, is superior to any other in this part of the country. The machinery is placed on the street floor in the power house on Albany street, opposite the hospital. There are three engines and three dynamos, besides the original boiler. The dynamos were built by the Siemens & Halske company, and the engines were built by the Ideal Engine company of Harrisburg, Pa., but the two companies consulted each other's plans and built, according to the specifications, combination machines. The most striking feature of the plant is the switchboard, which cost $3,500. It is of black enameled slate, 35 by 10 feet, and set in brickwork. The instruments with which it is equipped are all of special construction. The engines are self-oiling.

Since the Board of Railroad Commissioners announced its decision refusing to ratify the terms of the lease of the West End street railway to the Boston Elevated Railroad company, the directors of both companies have been in conference trying to draw up some form of lease which would be satisfactory to the commission, and at the same time meet the approval of the stockholders of both companies interested. A new lease has been drawn which will be submitted for approval to the stockholders of the West End at a special meeting called for December 9th. The new proposition provides for the lease of the West End to the Elevated company for a term of 25 years, at a guaranteed dividend of seven per cent. upon the West End common stock. The lease which was rejected by the railroad commissioners provided for a 99-year tenure and a guarantee of eight per cent. on the common stock of the West End.

Because of the grounding of an electric feed cable in a manhole on Summer street, on the morning of November 29th, the trolley system of the West End Street Railway company north of Dover street, and including many of the suburbs of the city, was tied up for about four hours. In the Summer street conduit are 18 cables of the West End company, including the trunk-line feeder cable, which starts from the power house in Albany street and runs down-town to Adams square. The first disturbance was noticed by a patrolman, who lifted the cover from the manhole. A cloud of smoke poured forth, followed by a column of flame. A large force of repairers was immediately put to work, and in a few hours the cars were running on schedule time.

A new corporation which intends to provide the connecting link between Boston, Providence, Fall River and New Bedford—the Norfolk Southern Street Railway company—was organized at the office of George S. Forbush, 53 State street, and the following-named directors were elected: Frederick S. Lane, John C. Lane, Edward F. Draper, George S. Forbush, Robert S. Gray, George P. Moore and Aaron R. Sanderson. At a meeting of the directors Frederick S. Lane was elected president, John C. Lane vice-president, and Edward F. Draper clerk and treasurer. The new line is to be built from Norwood, through the towns of Walpole and Foxboro to Mansfield, and with the completion of this and the line from Mansfield, Boston will have trolley connection with Providence, New Bedford, Fall River, Attleboro, Brockton and Taunton, making the Norfolk Southern an important link.

The action of the City Council of Laconia, N. H., in granting a franchise to the Electric Light and Power company in every way satisfactory, assures the early lease of the East Tilton power and the construction of the plant, which will double the accessible power for manufacturing purposes in Laconia. Several large contracts for power have been made, and the town of Belmont, adjacent to Laconia, has just granted a franchise to the company for the erecting of wires for the transmission of electricity for both power and lighting. Over $100,000 will be invested in the plant at once.

C. S. G.

Northwestern Notations.

Minneapolis, December 7.—The council of the city of Oshkosh, Wis., recently granted an amendment to the franchise of the Citizens' Traction company, which was objectionable to some of the citizens. The mayor left town without returning to the city clerk the ordinance with his approval or veto. On the last day the president of the council, as acting mayor, approved the ordinance, and half an hour later a message was filed from the mayor, which had evidently been left by him when he went out of town, vetoing the ordinance. Now the question is, which signature takes precedence—the acting mayor's in the city or that of the mayor when not in the city.

The long-discussed question of better lighting at Grand Forks, N. D., has finally resulted in the award of the contract to W. I. Gray & Co. of Minneapolis for $12,703 to furnish a municipal electric lighting plant. It will have 125 arc lights of 2,000 candle power.

The new electric light plant for the city of Rock Rapids, Ia., has finally been completed and put in operation. Nearly 1,800 lights have been installed.

The electric light company of Greene, Ia., has recently put in a larger boiler to accommodate the demand for more light. The business now carries between 400 and 500 electric lights, besides street lights.

The burning out of an armature of the Electric Light and Power company of Oshkosh, Wis., caused a shut-down of the light system until the damage could be repaired. Andrew Thomoson has ordered a dynamo and other materials for an electric light plant for Dawson, Minn. He will operate it in connection with his machine shop.

It is probable that the city of Litchfield, Minn., may be obliged to put in a larger dynamo for its lighting plant to accommodate the increased call for lights.

The City Council of Ortonville, Minn., has finally rejected all bids for the electric light plant and will treat privately with contractors and manufacturers.

It is reported that Windom, Minn., has declined to supply any more residences with electric light, as the capacity of the plant will not permit it.

The city of Cumberland, Wis., has purchased new and second-hand materials for an electric light plant and will operate it in connection with the water works.

The Citizens' Electric Light company is the name of the proposed independent electric company at Aberdeen, S. D., which wants a plant to be operated on a longer schedule than the city plant uses.

The City Council has renewed a contract with the Electric Light and Power company of Menomonie, Wis., for street lighting. The president of the company announced that if the contract were renewed the company would put in a day service and expend $7,000 in improving the plant.

The General Electric company of Butte, Mont., has secured an option on the plant of the Phœnix Electric company, running until next May. It is understood the figure is $60,000.

The Northern Pacific Railway company will put an electric light plant in its yards at East Grand Forks, Minn., to furnish light for its buildings in East Grand Forks and also Grand Forks, N. D.

The Commercial Club of Duluth has joined in the chorus of complaint at Duluth, Minn., on the service that is given the West End and West Duluth. Lakeside people continue their complaint also.

City Clerk Matt Jensen of St. Paul has called for bids to furnish 120 arc lights of 2,000 nominal candle power to be placed where the present lights are, and 85 arc lights of 2,000 candle power to be placed where the council shall direct.

The plant of the McMillan Light and Power company in West Salem, Wis., was sold under the hammer in that city to Dr. E. C. Swartout for $3,000. When the new owner went to have the plant put in repair, Sam McMillan ordered the men to desist from work. When Dr. Swartout found this out he ordered them to resume, and they were again ordered to stop by the former owner, who stood guard over the property, armed. McMillan claims an ownership in the flume and waterwheel, notwithstanding the sale, and refused to allow it to be repaired. Arrangements have finally been made by which the repairs are being made. A lawsuit will probably result to settle the ownership.

The citizens of South St. Paul are agitating the extension of the Rice and Concord street car line to South St. Paul. Alderman Bell of the Sixth ward in St. Paul is strongly in favor of the improvement.

C. P. Wainman and J. W. Christie have been in Chicago on business connected with the Minneapolis telephone exchange, which will shortly be removed to the Telephone building.

In selecting a jury for the trial of Alderman George A. Durnam of Minneapolis for asking a bribe, the city attorney objected to J. W. Christie as a juror, on the ground that he, as manager of the Northwestern Telephone company, would be induced to favor the defendant. Mr. Christie did not think that the fact that the council had the power to take away the telephone franchise would influence him, but the next day changed his answer to one of the questions asked him and was excused. The incident is of interest in showing the relation of aldermen to those desiring franchises of any kind.

The American Steel Barge company of West Superior, Wis., has bought the electric generating plant which was originally bought for the Ironton Structural Steel company of Duluth, and will set it up in the barge works.

W. B. Clement has arranged to open an electric light plant at Cavalier, N. D.

United States Senator Turner, John A. Finch and A. B. Campbell of Spokane, Wash., are directors of a company which has been formed in New York to develop water power from the Pend d'Oreille River near its confluence with the Columbia, and transmit power to Rossland, Traill and other mining camps in the Kootenai district.

H. H. King & Co. of Jordan, Minn., have awarded a contract to put in an electric lighting plant to W. I. Gray & Co. of Minneapolis. The plant will be operated in connection with the flour mill and will furnish light for the town.

The Mantorville, Minn., Electric Light, Street Railway, Milling and Mercantile company has been incorporated with $50,000 capital stock.

The council of Valley City, N. D., is considering the purchase of a new dynamo to supply the demand for electric lights.

The Barnes Electric Light company of Maquoketa, Iowa, has applied for a franchise to run 25 years.

The Gas and Electric Light company of Green Bay, Wis., contemplates running wires to De Pere, Wis., to furnish light for that city.

The Gas and Electric company of Green Bay, Wis., has cut its arc light rates in two. It is a measure of competition to meet the new plant being put in by Allan Shewman.

The extension of the Mason City and Clear Lake, Iowa, electric line to Dougherty, Iowa, is proposed.

R. Williams has made a proposition to the council of Wheaton, Minn., to put in an electric light plant.

The council of Fergus Falls, Minn., will take bids on a new dynamo of either 1,800, 2,000 or 2,500 lights' capacity.

The Western Union Telegraph company has reduced tolls from Superior, Wis., and Duluth, Minn., to Northern Minnesota cities from 40 to 25 cents.

An electric light plant has been installed at the poor farm of Polk county, in Des Moines, Iowa.

The Board of Public Works of Racine, Wis., has ordered that electric light, telephone, telegraph and other poles for wires be painted different colors, in order that the owners may be known by the color of the pole. Red, white, blue, black, brown, yellow and green are the colors decided upon. The cause for this unique order is that the city lost a suit for damages for the death of a boy by an electric wire pole falling on him. The ownership of the pole could not be readily ascertained.

The press of Hillsboro, N. D., suggests that the matter of electric lights be considered.

The press of Rat Portage, Ont., thinks that an electric car line would prosper there with the cheap water power at hand.

The charter commission of Duluth, Minn., has decided to leave the appointment of a city electrician to the Board of Fire Commissioners, and he shall do the electric work of the police department.

The Chippewa Valley Electric Railway company of Eau Claire, Wis., has arranged for an extension of its lines on the Shawtown end in the spring, and will give improved service hereafter, 15 minutes service instead of 20.

The Des Moines Street Railway company of Des Moines, Iowa, has arranged for an extension of its lines to Valley Junction, Iowa, in the spring.

The estimated cost of an electric light plant for Whatcom, Wash., is $10,389.

The Park River mill at Park River, N. D., will

put in new boilers and engine and an electric light plant, at a cost of about $10,000.

The electric street railway of Madison, Wis., was sold to a trustee for the bondholders for $110,000. The bonds and interest due aggregate $174,412.

J. G. Ball has resigned as superintendent of the electric light works of Moorhead, Minn., and has been succeeded by Mr. Simengton.

Judge Lochren of the United States Circuit Court rendered a decision at Minneapolis a few days ago of some interest to electrical men. A question in the theory of estoppel was raised in the joint cases of the Thomson-Houston Electric company and the Edison Electric Light company against the Minneapolis International Electric company, in arguing a demurrer by the defendants against a supplemental bill filed by the plaintiffs. The judge sustained the demurrer and held that estoppel could not be urged, because the analogy between this case and that of the same companies against the E. S. Bernard company (lately decided) was not complete. The Siemens & Halske company manufactures the appliances used by the defendant, and the plaintiffs claimed that it was the real defendant. The case involves the infringement of electrical patents, and the decision of the judge on the other points, which will be argued December 10th, will be watched for.

Representatives of the gas, electric lighting and street railway companies debated the question of franchises versus municipal ownership before the commission which is preparing a new charter for Minneapolis. Attorney Geo. B. Flannery appeared for the Minneapolis General Electric company, and argued strongly against municipal control of electric franchises. Among other things he stated that Detroit Mich., is the only city in the United States that keeps accurate statistics of electric lighting. C.

Washington, D. C.

Washington, December 6.—The extension of the long-distance telephone service is regarded with great favor in the government departments. It is a great relief to officials who wish to be away for short periods, or who are called way on business, for they can feel certain of being in constant and instantaneous communication with their respective departments. Secretary Bliss not infrequently holds conversations while he is in New York with officials of his department, and while here has interviews with his business managers in New York. Postmaster-general Gary when in Baltimore uses the same means in looking after the affairs of his department and while here in supervising his private business. Nearly all the cabinet officers do the same thing, and it is confidently asserted that more than one member of the cabinet would not be in such a position were it not for the convenience of modern means of communication, which no longer make it necessary for an official to be tied to his desk in the department over which he presides.

The Potomac Electric Power company has been notified that no permits will be granted to it after January 1st, unless the commissioners' request of September 18th, that a deposit of $500 be made, is complied with. The company has also been notified that it has overdrawn its deposit to the extent of $24.57.

Engineer Commissioner Black has received a report from B. C. Shipman, inspector of electric lighting, detailing a series of investigations made by him in regard to the installation and operation of the Brown underground electric system now in use on the Capital Railway company's lines on Eleventh and M streets southeast. He says: "I saw nearly all of the system installed and tested parts of it myself and have witnessed the first trial runs. In regard to the contact boxes and accessories, it appears that they were put in in a most careful manner and according to all the requirements of good engineering practice so far as compatible with the haste necessary. The fact that time was limited necessitated work in the rain sometimes, with the attendant risk, of course, that this work would afterwards prove faulty, the least moisture in cable work being fatal; but owing to the care exercised it has so far shown up very well. The bricks themselves, with the terminals in them, were tested, so I was informed, at 1,200 volts, more than twice the tension they will be called upon to resist. When the whole system was connected up I made a test at the power station and found the leak to be but two-tenths of an ampere, corresponding to .14 of a horse power. For half a mile of double track this is quite a fine showing, considering that a great deal of rain had fallen in the week preceding the test. From later developments it appears that even this leak was in a distributing cable and not in the boxes themselves. Since the time mentioned the cable has burned out in several places, and after having been repaired the small leak above noticed has apparently disappeared, according to the station apparatus, but no exact measurement of the leak has since been made. On numerous occasions in the spring and summer, before I was detailed on the work, the cable had burned out at various points. To come down to the present, since they have installed the improved brick, etc., they have had four grounds and burned-out cables. A conduit system in which each main, sub and branch wire is accessible at both ends, and susceptible of removal without disturbing the street, is imperative. With such a conduit system and the cable properly installed therein, I see no reason whatever why the Brown system, as at present developed, should not prove a commercial success and the cheapest solution of the overhead trolley question. It is perhaps but just to the manufacturers of the system to state that in the short time they had to install the road originally it was impossible to develop and obtain a conduit suitable for this system. I have been present at several trials of the car, both in the daytime and at night after 12 o'clock, and in no case since the porcelain cups have been put in has there been a 'live box.' Of course, it is possible for such a thing to occur, but hardly probable." T. I. P.

Canadian Intelligence.

Ottawa, December 6.—The receipts of the Hull electric railway for this year have exceeded those of last year by $31,000.

The Kingston electric street railway will be extended to Kingston Junction very soon, it is reported.

The earnings of the Toronto Street Railway company for the months of July, August and September show an increase of $35,323 over those for the same period last year. This increase is said to be due to the running of cars on Sunday and to the several conventions which were held in Toronto during the summer.

The statement of the Halifax (N. S.) Street Railway company for October shows an increase over the same month last year, not including receipts from electric lighting, of $1,620.

The annual statement of the Cornwall Electric Street Railway company shows total receipts of $25,283, and the surplus carried over, after paying interest on bonds, etc., is $1,359. The total capital is $150,000, and the company has in its treasury $35,800.

There is talk in Brantford, Ont., of constructing, at an early date, an electric railway from that city to Paris, Ont., a distance of seven miles.

Toronto capitalists are said to be inaugurating a scheme for the building of an electric railway between Woodstock and Ingersoll, both flourishing and large towns in the province of Ontario.

It is said that a movement is on foot to construct an electric railway from the town of Oshawa to the city of Toronto, equipped to carry passengers and farm produce to the city.

The Canadian minister of public works intends asking the Dominion Parliament, at its next session, for a large vote to extend the government telegraph lines in the Northwest and British Columbia, where the Dominion government already owns 700 miles of telegraph lines. The Public Works Department is at present considering whether it will be better to extend the present line from Quesnelle, B. C., to Dawson City, or simply build a short line, about 70 miles in length, across the Chilkoot Pass, connecting Dyea with Teslin Lake.

A company is said to have been organized at Hamilton, Ont., under President Myles of the Hamilton, Grinesby and Beamsville railway, with a capital of $200,000, to extend an electric railway from Beamsville to St. Catherines, a distance of 12 miles. The line will be commenced in the early spring. Much activity is being shown among the promoters of the electric road between Hamilton and Guelph. This latter road would have been constructed and in operation months ago, but for the opposition of farmers of Waterdown.

H. J. Beemer of the Pontiac and Pacific Junction railway has a big scheme in hand. It is his intention to purchase the North Shore line of the Canadian Pacific railway, and have the whole Quebec system operated by electricity, with headquarters in Hull. It is proposed, also, to operate the Gatineau railway by electricity as soon as the first scheme is carried out. The plant will, in all probability, be located at Lachute, as that water power is amply sufficient to provide a motive power for such a system.

The Civic Board of Control for the city of Toronto has awarded the contract for the city hall electric elevators to the lowest bidder, the Sprague Electric company of New York. It is said that the contract price is $29,875.

From all over Canada come reports of the utilization of water power for the purpose of generating electricity. The city of Belleville proposes drawing power for manufacturing from a falls near by, and Sterling will probably make use of the same service. In almost every large city in the Dominion steam-produced electricity has given place, or will shortly give place, to water-produced electricity, which is very much cheaper. Montreal has harnessed Lachine Rapids, Ottawa the power of the Chaudiere, Quebec the waters of Montmorency, Port Elgin the falls at Bull's Head, and a big scheme is now proposed to divert the waters of Chippewa Creek over the Hamilton Mountain and to supply electric energy therefrom for manufacturing enterprises both in the cities of Hamilton and Toronto. It is said that in the United States 157,000 horse power is secured in the form of electrical energy from water power, and in Canada about 15,000.

The British Columbia Electric Railway company has closed a contract to furnish power to the Esquimalt Waterworks company. A power house will be erected at Goldstream, with Pelton water wheels and generators, at which point the waterworks company will furnish the electric railway company with a sufficient quantity of water under an effective working head to develop electric power. The power will be transmitted to the company at Victoria, B. C., and there stepped down and applied to the various purposes for which it is required.

The Chateauguay and Northern Railway company at Montreal is making preparations to handle an extensive freight business in connection with the Canadian Pacific railway. It has ordered from the Canadian General Electric company four "G E 1000" equipments, with four controllers and commutating switches. The outfit, though of less capacity, is similar to that for the large locomotive recently supplied by that company to the Hull Electric company, which has handled as many as 33 cars on a shunt.

The Robb Engineering company of Amherst, Nova Scotia, received a cable from England recently, ordering three more Robb-Armstrong engines. The engines are, it is thought, for a new electric railway at Sheffield. A. V. W.

PERSONAL.

Luther Stieringer of New York was in Chicago early in the week.

Charles D. Shain of New York paid Chicago a flying visit on Wednesday.

Edwin G. Nourse, assistant engineer in charge of construction of the new bridge at Rock Island for the Davenport and Rock Island Bridge and Terminal company, was instantly killed by a falling derrick on the morning of December 8th. Mr. Nourse was one of the best known engineers in the West. He gained particular distinction by designing the railroad terminal tracks entering the World's Fair grounds in Chicago.

Alonzo S. Kimball, professor of physics at the Worcester Polytechnic Institute, is dead. He was born in Center Harbor, N. H., in 1843, and was graduated from Amherst College in 1866. He established the departments of physics and electrical engineering at the Polytechnic Institute, and was a lecturer for a number of years at Mount Holyoke College. He contributed a number of valuable papers to scientific publications and scientific societies, and was a member of the American Academy of Arts and Science and of the American Institute of Electrical Engineers. He leaves a widow and three children.

ELECTRIC LIGHTING.

It is said that the catacombs of St.. Calixtus in Rome were lighted by electricity for the first time on November 23d.

The Harrison Electric company of Allegan, Mich., has secured from the City Council the passage of a resolution authorizing it to furnish 68 arc lights for the streets.

The contract for changes and additions to electric light conduits and wiring in the Omaha public building has been awarded to the Industrial Iron Works of Omaha, at $882.75.

The City Council of Gilman, Ill., has entered into contract for a term of 10 years for 23 all-night arc lights of 2,000 nominal candle power each and the operation and maintenance of the water-works plant for $1,600 per annum.

The secretary of state of North Carolina has been asked to issue a charter to the Sanford Water and Light company; capital, $25,000. It is proposed that the people of Sanford shall guarantee interest on $25,000 of the company's first-mortgage bonds.

Bids were opened on November 30th for tubing and wiring the St. Paul postoffice as follows: McKay-Howard Engineering company, Baltimore, $6,120; Southern Electric company, Baltimore, $5,766.66; Western Electric company, Chicago, $5,170; P. T. Dunn, St. Paul, $8,250; Northwest Engineering company, St. Paul, $7,500.

The Treasury Department is inviting sealed proposals until December 21st for installing in the United States postoffice building at Saginaw, Mich., a system of electric light wiring and interior conduits for the same. Specifications can be had upon application to the chief clerk of the Treasury Department, Washington, D. C., and to the superintendent of construction of the building. Plans, showing the location of the lights, can also be seen upon application to the superintendent.

The time for opening bids for installing an electric light and power plant in the United States postoffice building at Washington, D. C., has been extended from November 30th to December 30, 1897. Proposals will be received as follows: First, for tubing and wiring the building; second, for dynamos and engines; third, for the plant complete. All necessary information relative to this contract can be obtained upon application to the chief clerk of the Treasury Department, Washington, D. C.

North Clark street in Chicago has been repaved and greatly improved, and it is to be especially lighted by concerted arrangement. It is proposed

to place an arc light in front of each store at a uniform height and above the center of the sidewalk. The Chicago Edison company has entered into an agreement to furnish lights on a two-year contract at $1.70 a week, the lights to burn until 12 o'clock, or $1.25 for lights burning until 12 o'clock Saturday nights and until 10 o'clock other nights of the week. The light soliciting committee has secured contracts from the business men of several blocks. As soon as the committee secures a contract from every man in a block it will order the light turned on that block and use it as an argument on the business men in the adjoining block. Out of 300 business places the committee expects to secure contracts that will provide North Clark street with 250 sidewalk lights in a few weeks.

ELECTRIC RAILWAYS.

Postmaster-general Gary states that the greater expedition to the mails secured through transportation on electric cars has created an increasing demand for the extension of the service. There are more applications now pending in the Postoffice Department for the establishment of electric-car mail service than can be met from the appropriation for the current year. The annual rate of expenditure for the electric and cable-car postal service on June 30, 1897, was $183,038.43. Uniform rates of pay have been adopted, based on space and mileage.

TELEPHONE.

The Harrison Telephone company of Toledo, O., has passed into the hands of a receiver. It appears that the company defaulted in the payment of the interest on its bonds over a year ago. The petition has been filed in the Common Pleas Court at Toledo, and Daniel Morris was appointed receiver under $15,000 bond.

It is stated at Florence, Ala., that there is a strong probability that the fight against the Bell Telephone company, which recently came to an end with the sale of the property of the Citizens' Telephone company, will be reopened and waged still more bitterly. It became known on November 27th that the Bell company would reinstate the former prices as soon as the present contracts expire, and the subscribers are literally up in arms at the proceeding, and a plan is being talked of for a determined fight.

In Baltimore, on November 30th, the grand jury found presentments against F. B. Hubbell, William J. Atkinson and James Russell, president, secretary and treasurer of the Best Telephone company, charging them with having made false reports of the financial condition of the concern, with intent to deceive. The prosecuting witnesses are all members of the Baltimore Stock Exchange. According to the story told before the grand jury, Atkinson caused to be made to the Stock Exchange a sworn statement, signed by Hubbell and Russell, that the corporation had assets of about $2,500,000. This was done for the purpose of inducing the exchange to list the company's stock. The Stock Exchange refused to list the stock, the creditors of the telephone company became pressing, and Mr. Atkinson had the concern placed in the hands of receivers. The receivers found that the assets of the company were worth not more than $12,000 or $15,000.

MISCELLANEOUS.

The Atlantic and Pacific Aerial Navigation company of San Francisco has just had made by the Pittsburg Reduction company, at the works of the latter in New Kensington, Pa., aluminum sheets for the manufacture of a cylinder 38 feet and two inches in diameter, which will have a forward cone of 50 feet and a rear cone of 45 feet, to be used in the construction of an air ship. This ship will be propelled by a gasoline engine of 105 horse power and have a carrying capacity of more than a ton. When completed it will weigh 5,000 pounds and cost about $15,000. The order is a duplicate of one filled about a year ago.

TRADE NEWS.

The property of the Armington & Sims Engine company in Providence is to be sold at auction by the creditors' committee at noon on December 29th.

Charles Wirt of Philadelphia is renewing old acquaintances in Chicago and showing the trade the new Wirt rheostat. His temporary address is 1564 Monadnock building.

Type "S" solenoid blow-out controller is described in a dainty booklet written by Prof. Short and published by the Walker company. The mechanical execution of this little book is of noteworthy excellence.

The Burnley Battery and Manufacturing company of Painesville, O., reports that within the last few months it has received from dealers and others testimonials to the effect that the Burnley dry battery is the best on the market, both for work done and ability to hold up its value over long periods of time. The latter feature is attained by adding in a certain proportion to chloride of zinc a new chemical which the company found, after severe tests, to almost if not entirely stop waste by loss of moisture. Chloride of zinc alone has been used for this purpose, but has not filled the bill. Those who have use for dry batteries wherein service is required to extend over long periods of time are asked to investigate the merits of this new feature by trying the Burnley dry battery.

D. A. Kusel, proprietor of the D. A. Kusel Telephone and Electric Manufacturing company, 1110 Pine street, St. Louis, announces that he has just completed a contract with the company running a toll-line from Kell, Ill., to Hickory Hill, Ill. This equipment, under the order, requires at least 25 instruments, and reflects credit on the skill of Mr. Kusel as a manufacturer of high-class instruments.

The firm of Meysenburg & Badt, Chicago, consulting and contracting engineers, of which Lieut. F. B. Badt is president and Edward A Meysenburg secretary and treasurer, has met with such good success in its undertaking that it has already been found necessary to remove to larger and more commodious quarters. The firm is now located in rooms 1503 and 1504 Monadnock block, where it will be better able to take care of its constantly increasing business. The firm represents such well-known establishments as the Weston Electrical Instrument company, make of the world-renowned Weston instruments; Hugo Reisinger, importer of "Electra" high-grade Nuremberg carbons; Ward Leonard Electric company, manufacturer of the Leonard and Carpenter rheostats; Helios Electric company, maker of arc lamps; Excelsior Electric company, maker of electrolytic dynamos, and the K. & W. company, manufacturer of the Hardy incandescent lamp and K. & W. specialties. With so choice a line of specialties it would seem impossible for Meysenburg & Badt not to be successful. Besides, they are doing, as usual, a good business in the contracting and consulting lines.

Stationary engineers have no problem that so much annoys them as scale in steam boilers. The presence of scale or sediment in a boiler results in loss of fuel, burning and cracking of the boiler, predisposition to explosion, and necessitates extensive repairs. It is estimated that the presence of one-sixteenth inch of scale causes a loss of 13 per cent. of fuel. The boiler expurgator, manufactured by the Boiler Expurgator company of Chicago, is designed to remove the scale from steam boilers, and save money by holding the surface of the boiler in a natural condition. The boiler can be run a longer time between washings, which reduces the expense of more frequent washing. The advantage of longer runs is that it avoids the serious injuries that result from frequent heating up and cooling off boilers. Repeated extremes of contraction and expansion are hard on boilers. The boiler expurgator prevents and removes scale, is also a preventive of foaming, and is effective alike in all kinds of water. It has met with great favor from users, and those wishing to investigate its merits are asked to correspond with the manufacturer or its agents. The boiler expurgator, as well as Holm's "Tesoline" commutator compound, which is manufactured by the same company, is handled by the following-named selling agents: Chas. B. Boothe & Co., Los Angeles, Cal.; Caldwell Bros, Tacoma, Wash.; Hendrie & Bolthoff Manufacturing company, Denver, Colo.; H. P. Yale & Co., Milwaukee, Wis., and the Southwick Oil and Grease company, San Francisco, Cal.

December 4th was moving day for the Sprague Electric Elevator company and Interior Conduit and Insulation company of New York, as both of these concerns moved to the Commercial Cable building, 20 and 22 Broad street, where they will occupy the entire fifteenth floor of this building, with one of the best locations and most conveniently equipped suite of offices in New York. Vice-president E. H. Johnson and Second Vice-president Frank J. Sprague are located in spacious and sightly offices which are especially arranged for their convenience. The concentrating of the offices of two large lines of business necessitated a great deal of attention to detail, but it is in evidence that this has been done to the best advantage in the arrangement of the treasurer's office, general sales department, contracting office, bookkeeping department, drafting offices, billing room and mailing and filing department. Although it might be expected that some confusion would ensue from such consolidation of interests, it was not seen at the offices. On Monday business was being transacted as usual, and all callers were served with that prompt attention which has always been observed at the previous locations of these companies. The scope and variety of the electrical apparatus which has been manufactured by the two concerns will be very materially added to along the lines which have been planned, and it is apparent that a company of this nature is in a position to furnish not only full outfits in electric lighting and power plants for the average installation, but can furnish complete power installations and complete railroad systems. It is likely to become one of the great electrical industries of this country.

BUSINESS.

The Hartley Electrical Works, 263 Randolph street, Chicago, are receiving considerable repair work, of which they make a specialty. The company also buys and sells second-hand electrical machinery.

The Warner telephone generator is becoming quite popular among telephone men; so much so, that the manufacturer, W. F. Warner, Muncie, Indiana, has been unable to keep up with his orders since the machine was first introduced.

M. I. Vought, LaCrosse, Wis., manufacturer of the well-known "two balls" adjustable hanger for incandescent lamps, is meeting with great success with this useful device. It will require much overtime work to catch up with the orders now on hand.

The Reliable Electrical Supply company, 236½ Madison street, Chicago, is meeting with gratifying success in its business. Although a new concern, it has firmly established itself in the electrical business, and has already secured many permanent customers who are said to be more than satisfied with the excellent treatment received at the hands of the Reliable company.

The Packard transformer is still holding its reputation for indestructibility. As now made this transformer is so thoroughly insulated that it seems almost impossible to burn it out. In only very rare cases has it been unable to withstand severe lightning discharges. This immunity from burnouts has made the Packard transformer very popular, and the Electric Appliance company is reaping the benefits of its popularity this fall in a largely increased trade.

The O. C. White company, Worcester, Mass., is having great success with its adjustable holders for incandescent lamps. This useful article has been on the market a long time, has been thoroughly tested and seems to meet with general favor. The White company is kept busy filling orders for these holders, and those who are not already using them and are in the market for an article of this kind may find it to their interest to get further information from the company.

Hugo Reisinger of 38 Beaver street, New York, sole agent of the celebrated "Electra" highest grade Nuremberg carbons, says that the outlook for the present season is most promising. The large and numerous orders that have lately reached him prove not only an increase in business, but that station managers are fully aware of the advantages gained by the use of this carbon. The European factory Mr. Reisinger represents has been enlarged recently, thus enabling him to fill orders for the largest quantities of carbons on short notice.

John Child, western agent for A. O. Schoonmaker of New York, is exhibiting at his Chicago office a magnificent piece of mica. Mr. Child is doing excellent work for the Schoonmaker mica, and this evidence of the splendid character of the product which he is disposing of should interest purchasers. There is, as is well known, a good market for mica for various purposes in the West, and there is no reason why, with such an excellent mica to handle, Mr. Child cannot greatly increase his business during the coming year.

The eleventh edition of the annual catalogue of W. R. Ostrander & Co. of 22 Dey street, New York, is out. This is the largest catalogue which has been as yet issued by this firm, containing 247 pages of matter of interest to the electrical trade. It has a complete list of all the goods which are manufactured by this concern. Because of the enlargement of the factory, the firm is enabled to increase its business. Especial attention has been given to the hiring of skilled mechanics and to better shipping facilities, the latter enabling the concern to fill all orders promptly. One of the prominent features in the catalogue is the large number of designs for speaking-tube whistles and annunciators; but it would seem that about everything that a possible purchaser could desire could be found in this catalogue, which is profusely illustrated. A new department has been made for the handling of telephone and telegraph supplies. W. R. Ostrander & Co. have steadily advanced in their line of business, and have paid special attention to the manufacture of patented articles controlled by themselves in the line of speaking tubes, hardware, electric bell goods, electric light material, telegraph and telephone goods.

A quarter of a century ago less than a score of firms were engaged in the manufacture of piston packings. Of late years hundreds have engaged in the business, and every engineer knows that the market is flooded with all kinds of packings. The use of some of these may get him into trouble. The great increase in the use of steam machinery, with higher speed and higher pressures, has created a demand for superior packings for the pistons and plungers of engines, pumps, pumping, hydraulic and ice and refrigerating machinery. There is one firm in this line whose reception from the start was of a most cordial nature, through its untiring efforts to serve its patrons faithfully and with high-grade packing of known reliability for quality, durability and economy. The word Garlock stands for excellence in the manufacture of packings for steam, water, gas, ammonia, etc., and is recognized by engineers in every country. The

customers of the Garlock Packing company are numbered by the thousands in all civilized sections of the world. The steam engine has been the great civilizing agent of the world, and wherever it is found, there, also, are Garlock packings; the two go hand in hand in nearly every part of the globe.

Devoting themselves to the production of electrical novelties, the gentlemen in charge of the Ohio Electric Works of Cleveland have made an enviable reputation. The company is working night and day to meet the demand for its battery table lamp, necktie light, dollar motor and bicycle light. Those in charge know the different needs of all branches of the business, and they are prepared to fill orders promptly from the comprehensive stock carried at all times or by special contract. The productions of the Ohio Electric Works are characterized not alone by fitness of material and excellence of workmanship, but by originality and merit of design, worked out by the employes of the company, who are, of course, especially skilled in the work of this house. The head of the concern gives his personal supervision to every department, and the company is able to invite correspondence with complete confidence in its ability to offer inducements which cannot fail to compel favorable consideration. The Ohio Electric Works desire agents everywhere to sell the four leading electric novelties before mentioned. Excellent terms will be extended, and those desiring pleasant and profitable employment are requested to enter into correspondence with the company.

The Wheeler Reflector company of Boston, Mass., manufacturer of the celebrated Wheeler reflectors, reports an increasing demand for reflectors, shades, etc., of which it makes hundreds of different styles. A specialty in this line is show-window lighting. Merchants are recognizing the importance and value of well lighted stores and show windows; and the extensive use of electricity and patent gas burners for this purpose has made reflectors and shades almost a necessity when the matter of efficiency and economy is considered. The Wheeler system of reflectors, electric, oil and gas, is based on the general principle of special shapes for special uses, and numerous styles have been originated on mathematical principles, thus saving and making useful light that otherwise would be wasted. This company also manufactures electric and oil headlights for street railway use, and has recently brought out another electric headlight, with parabolic reflector, requiring no hole in the dashboard, and which projects but 4½ inches, being amply protected by the buffer. The superiority of this headlight is being proved by its exceedingly rapid adoption on street railways throughout the country. For nearly a score of years the Wheeler Reflector company has been bringing out specialty after specialty of recognized practical merit, the value of which has been attested by that imitation by other makers which is the sincerest flattery. The latest catalogues of the company show the progress that is being made in up-to-date illumination.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued November 30, 1897.

594,379. Electric System of Propulsion. William M. Brown, Johnstown, Pa. Application filed May 11, 1897.

Motors and an electro-magnetic closer are carried by the vehicle, and an energizing coil for the closer is fixed in series with the motors and connected through a switch to the terminals of an independent source of electric supply carried by the vehicle.

594,382. Signaling System. Henry A. Chase, Boston, Mass. Application filed January 23, 1893.

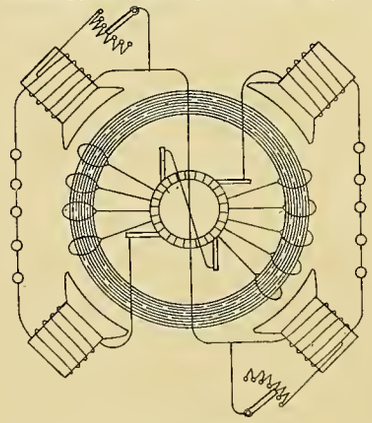
A signal transmitting apparatus is constructed to transmit a number of impulses indicative of the apparatus and additional impulses indicative of different signals, and comprises a receiving instrument or relay responsive to all the impulses transmitted, an audible signal normally passive or non-responsive to the impulses indicative of the apparatus, and a controller for the audible signal governed by the relay and controlling the operation of the audible signal to cause the audible signal to become responsive to each additional impulse indicative of the different signals.

594,386. Electric Contact Device and Conductor Construction Therefor. John M. Dortch, Johnstown, Pa. Application filed January 19, 1897.

An electric contact device is carried by the conductor, having a plurality of supporting portions and cam-faces in alignment with the conductor hangers.

594,407. Telephone Line Switch. Gilbert Lay, Licking, Mo. Application filed October 10, 1896.

This switch comprises a movable pair of connected metallic arms, a second pair of such arms, insulated bridging strips on one arm of each pair, and stationary contact points connected to the line wires, and an intermediate connecting plate spanned by the bridging strips.



NO. 594,489.

594,426. Electric Arc Lamp. Henry R. Quinby, Rochester, N. Y. Application filed February 18, 1897.

There is the combination with the movable armature having the tapering recess, of the carbon clamp embodying the collar through which the carbon passes movable in the recess, having the radial apertures and the balls arranged in the apertures and engaging the walls of the tapering recess, and also the carbon, and a releasing projection co-operating with the clamp collar.

594,435. Combined Gas and Electric Generator Plant. Sidney H. Short, Cleveland, Ohio. Application filed May 4, 1896.

A gas retort, means for heating the same, a coke-holder communicating with but insulated from the retort, an electrolyte in which the carbon-holder is immersed, a material electro-negative with respect to the coke, and means for heating the electro-negative material and electrolyte by the products of combustion of the retort-heating means.

594,471. Electrically Controlled Block Signal for Railways. Robert J. Hewett, St. Louis, Mo. Application filed August 20, 1896.

A block having a plurality of insulated track sections is described, each section being provided with an independent track circuit, signals in independent signal operating circuits for each direction of travel, and interlocking magnetic devices controlling the signal circuits and included in the track circuits.

594,488. Polycircuit Dynamo. Irving R. Prentiss, Cleveland, Ohio. Application filed November 9, 1896.

A multipolar dynamo-electric machine having separate independent circuits, each connected with part of the poles and their corresponding brushes and disconnected from the other poles and brushes.

594,489. Polycircuit Dynamo. Irving R. Prentiss, Cleveland, Ohio. Application filed March 31, 1897.

A closed-coil armature having the brushes under each pair of field magnets of opposite polarity connected in series with an external circuit is described.

594,493. Electric Brake. Sidney H. Short, Cleveland, Ohio. Application filed May 10, 1897.

Claim is made for the combination with circuits closed upon themselves in a closed magnetic field of means for inducing heavy currents in the closed circuits.

594,575. Electrically Operated Switch. Walter D. Stanton, Springfield, Mass. Application filed January 14, 1897.

In an electrically operated railway switch the combination with insulated sections of the main and siding rails, of a pivoted switch-rail movable in a horizontal plane, an electro-magnet located beneath and at a distance from the free end of the switch-rail, and having electrical connection with one of the insulated rail-sections and also with one of the main or siding rail-sections, a lever moving in a vertical plane and interposed between the magnet and switch-rail, the lever being fulcrumed at an intermediate point in its height, and having a loose connection at its upper end with the switch-rail, and a retracting spring connected to the lever.

594,585. Electric Arc Lamp. Thomas E. Adams, Cleveland, Ohio. Application filed January 21, 1897.

One claim is for the combination with a lamp-arm having a pin or projection thereon, of a carbon guide comprising an expansible body portion provided at one of its ends with an arm adapted to engage the pin or projection on the lamp arm, and fingers projecting upwardly and inwardly from the body portion, the fingers having pointed free ends to engage the carbon passing through the guide.

594,618. Electric Switch. Monroe Guett, Hartford, Conn. Application filed May 29, 1897.

Push-buttons are connected with the oscillating plate; a locking lever is adapted to engage with the plate during a part of its oscillation; a crank arm is engaged by a locking lever; a spindle is connected with the crank-arm; poles are mounted upon the spindle, and a spring is arranged to engage with the oscillating plate and also with the crank-arm.

594,656. Electric Switch. Ferdinand Schwedtmann, St. Louis, Mo. Application filed December 14, 1896.

A suitable contact part is adapted with a switch-blade to make contact, a solid pivot post carrying the switch-blade and having formed in it a slot at the termination of the opening for the reception of the switch-blade, and a contact spring firmly secured in the slot with the free end between the pivot post and the switch-blade.

594,665. Electric Brake. William Weihl, New York, N. Y. Application filed October 22, 1896.

Electro-magnets are mounted to vibrate, and means are provided for closing a circuit through the electro-magnets; a hand-brake is provided with a gear-wheel; a brake rod is connected with the operating lever of the electric-brake system and is provided with a rack engaging with the gear-wheel on the hand brake, and a ratchet wheel and pawl in connection with the hand-brake.

594,678. Electric Burglar Alarm. Thomas A. Clarke, Bootle, England. Application filed January 12, 1897.

Two portions form the upper and lower parts of the wedge, with a series of thin contact plates forming the hinge and arranged with contacts of opposite polarity side by side and covering a greater portion of the surface of the wedge, whereby if a metal tool be used to push it away it will complete the circuit by bridging the distance between two contacts.

594,682. Electric Arc Lamp. Thomas E. Drohan, Chicago, Ill. Application filed July 9, 1897.

Features of this mechanism are a tubular part through which the carbon is adapted to be fed, of a trigger adapted to rest upon the carbon as it is fed through the passage and to engage with the tubular part after the carbon has passed the trigger.

594,687. Commutator. Charles J. Greiner, St. Louis, Mo. Application filed August 31, 1897.

A commutator cylinder has a periphery consisting of certain segments, other segments arranged alternately with the former segments, while still other segments are arranged in longitudinal alignment with the second segments, and the non-conducting surfaces are arranged in alignment with the first segments.

594,700. Electric Pleasure Railway. Luke Lilley, Cincinnati, Ohio. Application filed February 4, 1896.

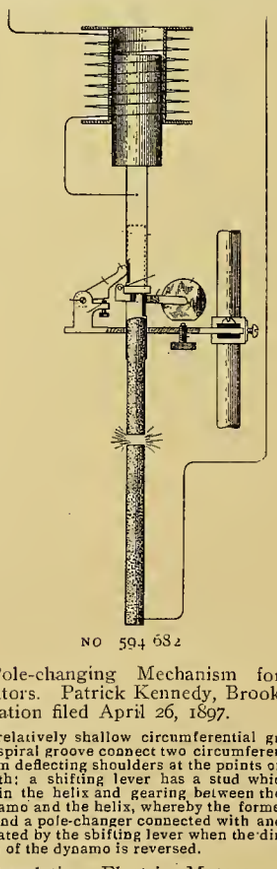
This invention consists of inclined railway tracks leading to the base of a dark tower and thence spirally around the inside of the outer wall of the tower to the top, the track leading to the base of an observation tower, with a spiral railway arranged around the outside and leading to the top, forming an observation tower.

594,702. Electric Railway. Robert Lundell, Brooklyn, N. Y. Application filed August 24, 1896. Patented in England September 17, 1896.

Three sets of surface contacts are employed, one set being connected to the positive or plus current main, the second to the negative or minus main or return, and the third set connected to the track rails through switching electro-magnets.

594,744. Means for Controlling Electric Currents. Patrick Kennedy, Brooklyn, N. Y. Application filed April 26, 1897.

One claim is given: In a device for controlling electric currents, the combination with a dynamo, an external circuit fed by said dynamo, a solenoid in said external circuit, the movable core of said solenoid and its spring, a rheostat in the field magnet circuit of the dynamo, and mechanism substantially as described whereby the movement of the solenoid core controls the resistance in the said field magnet coils, of a branch circuit from the main exterior circuit, means for breaking said branch circuit, an electro-magnet in said branch circuit, an armature lever, one arm of which is coupled to the spring of the solenoid core and the other provided with an armature in the field of force of said electro-magnet and said armature, whereby when said branch circuit is broken the tension of said spring is reduced.



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594,745. Pole-changing Mechanism for Electric Generators. Patrick Kennedy, Brooklyn, N. Y. Application filed April 26, 1897.

Two relatively shallow circumferential grooves and a deeper spiral groove connect two circumferential grooves and form deflecting shoulders at the points of intersection therewith; a shifting lever has a stud which engages a groove in the helix and gearing between the armature of the dynamo and the helix, whereby the former rotates the latter, and a pole-changer connected with and adapted to be operated by the shifting lever when the direction of the rotation of the dynamo is reversed.

594,779. Regulating Electric Motors. Albert G. Davis, Washington, D. C. Original application filed November 17, 1896. Divided and this application filed July 17, 1897.

A plurality of motors is coupled in tandem, with phase-advancing devices adapted to neutralize in whole or in part the self-induction of the intermediate circuits.

594,800. Electric Rail Bond. Slaughter W. Huff, Baltimore, Md. Original application filed August 29, 1896. Divided and this application filed March 11, 1897.

A bond for electrical connections, comprising a flat-metal body portion composed of a number of parts which render it flexible edgewise, and attaching lugs integral with the ends of the body portion and formed of the same original body of metal as the body portion.

Western Electrician.

EVERY SATURDAY.

Vol. XXI. CHICAGO, DECEMBER 18, 1897. No. 25

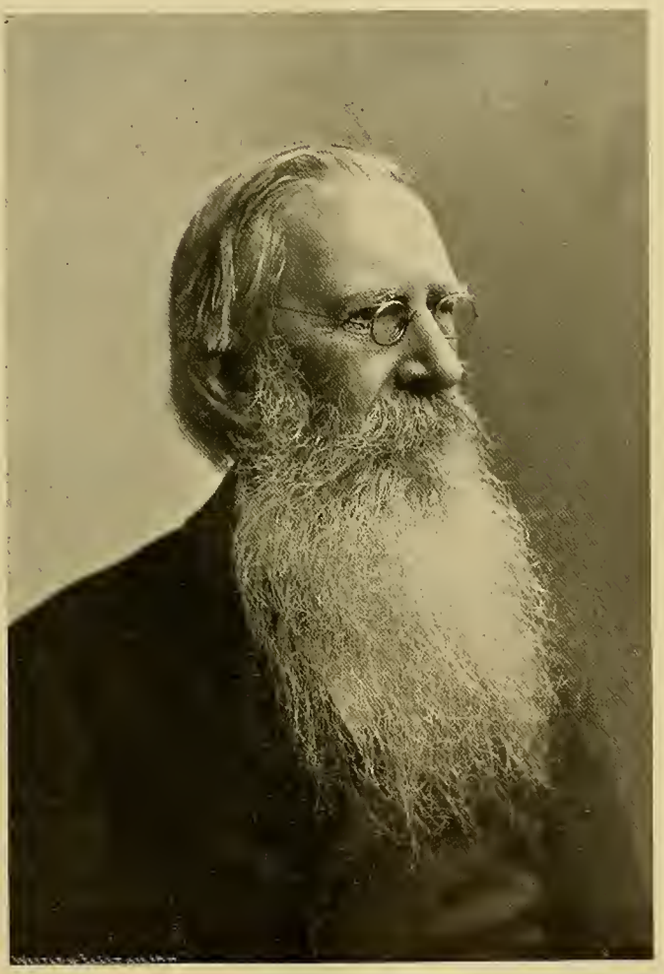
Death of Gardiner Greene Hubbard.

A conspicuous figure in the early history of the telephone and probably the most important factor in the commercial development of the industry, passed away in the death of Gardiner Greene Hubbard early Saturday morning, December 11th, at his country residence, Twin Oaks, Woodley Lane, near Washington, D. C. Mr. Hubbard's health had been failing for several weeks, but the announcement of his death found his friends wholly unprepared for the shock. It was known that he was in ill health, but there had not been the slightest knowledge of his serious condition, which steadily grew worse during Friday afternoon and night, until the time of his death, three o'clock Saturday morning. His last appearance before the Geographic Society, in which organization he always took great pride and interest, was on the evening the members of the organization made an excursion to the Naval Observatory and inspected the scientific instruments used in that department of the government's work. Mr. Hubbard did not accompany the party, but on their return trip the members called at Twin Oaks and spent a short while with their president. Mr. Hubbard seemingly enjoyed and appreciated the impromptu visit very much, and entertained his guests in his usual hospitable manner. His last appearance at a public function was on the evening of October 26th, the occasion of the reception tendered Dr. Nansen, the arctic explorer, at the Arlington. President Hubbard received the guests. Shortly before this he had accompanied the scientists on their excursion to Cabin John Bridge and participated in the field work of the day. He was also present and presided at the lecture of Prince Kropotkin at the Columbia Theater. On this occasion Mr. Hubbard was also seemingly in the best of health. He introduced the lecturer and sat through the afternoon an interested listener to all that was said about Russia and the Siberian territory. After the Nansen reception Mr. Hubbard was seldom seen in public, however. He was compelled to appoint someone to preside in his stead at the subsequent meetings of the society.

Mr. Hubbard's career was truly remarkable. He was born at Boston on August 25, 1822, and throughout his entire life continued intimately associated with the affairs of his native place, for which he had a strong affection. His father was Samuel Hubbard, a justice of the Supreme Court of Massachusetts, and his mother was a daughter of Gardiner Greene of Boston, then one of the three wealthiest men in America. The Hubbard family is a very old and honorable one in Massachusetts. Gardiner Hubbard was graduated from Dartmouth College in 1841, and after studying law at Cambridge was admitted to practice in 1843 in Boston. In 1873 he went to Washington, where he practiced law until 1878.

At that time he became interested in telephony and gave up the practice of law to devote all of his attention to the commercial development of the invention that was then considered even by Bell himself a mere toy. He formed the National Telephone company that exploited Bell's original patent and was afterward merged into the American Bell Telephone company. He was the controlling spirit in the enterprise, and it was his shrewd management and prescience that enabled the Bell interests to maintain their commanding position in the telephone field in spite of all competition. The policy of the parent company in retaining control of the exchanges and the operating companies renting instruments to subscribers instead of selling them outright, was Mr. Hubbard's idea, and was only one of many steps he took which made the telephone for many years the absolute property of the Bell interests. He went to Europe and organized several telephone companies, among them the International and the Oriental. He recognized the worth of the Berliner invention, which has since been the subject of bitter controversy, and purchased it before any separate company could be organized to exploit it. Valuable concessions were granted to him by the Russian government, and he repaid the empire by giving it one of the best telephone systems in Europe. He retained his connection with the parent company, although he had long since retired from the active management of the concern.

While he resided in Massachusetts Mr. Hubbard was interested in many public enterprises, his most notable achievement being the establishment, through his influence, of the Clarke School for the Blind at Northampton. He was for 10 years a member of the Massachusetts State Board of Education, and of the Centennial Commission of 1876. President Grant appointed him in 1876 a special commissioner to investigate the subject of railway mail transportation. Mr. Hubbard was a strong advocate of government ownership of railroads. He was an eloquent and logical speaker, and possessed high education and refinement. He was perhaps most popularly known as president of the National Geographic Society. He was also first vice-president of the American Association to Promote Oral Instruction of the Deaf, and of the American Association of Inventors and Manufacturers. He was a



GARDINER GREENE HUBBARD.

member of the board of trustees of the Church of the Covenant, the Board of Trade, and also of the Columbian University; a member of the Board of Trustees of the Clarke Institution of Northampton, Mass., and of various other corporations and benevolent associations.

The funeral services were held at the Church of the Covenant in Washington and the burial at Rock Creek cemetery. The honorary pallbearers were Justice Brown of the United States Supreme Court, Senator Hoar, ex-Senator Dawes, President Gilman of Johns Hopkins University, President Whitman of Columbian University, ex-Secretary John W. Foster, ex-Secretary Herbert, Professor Langley of the Smithsonian Institution, Professor Newcomb of the Naval Observatory, Major Powell of the Bureau of Ethnology, Anthony Pollock and James E. Fitch. The active pallbearers were the 16 officers and members of the board of management of the National Geographic Society, as follows: General A. W. Greely, Marcus Baker, William H. Dall, C. Hart Merriam, Professor C. K. Gilbert, H. S. Ogden, Everett Hayden, Henry Gannett, H. F. Blount, W. J. McGee, C. W. Dabney, F. H. Newell, David T. Day, W. B. Powell, John Hyde and John B. Wight.

The following appreciative sketch by William E. Curtis, the Washington correspondent of the Chicago Record, will be read with interest:

"One of the best men that ever lived will be buried under the naked trees of Rock Creek cemetery tomorrow—Gardiner Greene Hubbard. His noble life was prolonged for 76 years, but was terminated suddenly last Saturday morning at the height of his usefulness, even while his generous soul was engaged in forming plans for the benefit and happiness of his fellow-men. He was blessed with great wealth, and appreciated fully and sensibly the advantages and opportunities it afforded for doing good. Although he retired from what is called active business many years ago, few men had less leisure or enjoyed labor more, for he transferred his activity from one field to another, and his mind, his hands and his money were busy in enterprises in art, science, literature and philanthropy, instead of buying and selling merchandise. Surrounded by the luxuries, comforts and conveniences, with two hospitable mansions—one in this city and one on the hills overlooking Washington—filled with books and pictures and statuary, and all that attracts and engages men of refinement and culture, he lived a simple, frugal, unostentatious life, whose happiest hours were spent with his grandchildren, planning for their pleasure and watching their games or arranging hospitalities for the entertainment of his friends. One of his daughters is the wife of Charles J. Bell, a banker of this city, who had charge of the inauguration ceremonies last March. Another is the wife of Alexander Graham Bell, the inventor of the telephone. Mr. Hubbard conducted the business transactions in the development and practical application of that invention. For several years he was the active head of the Bell Telephone company, but after it was fully organized he retired in favor of younger men who had the benefit of his training and always sought his advice upon matters of importance. It would take many pages to describe the marked characteristics of his unique personality and the various enterprises in which he was engaged and the achievements he accomplished. The great hobby of his later life was the National Geographic Society, and the only honor he sought was the presidency of that organization. He was a regent of the Smithsonian Institution, a director in many financial, industrial and benevolent corporations, the chairman of the board of trustees of the Presbyterian Church of the Covenant, the silent partner in many enterprises of charity, the unseen "angel" behind many undertakings and publications in science, literature and art, and was always a bank upon which one could draw when money was required for a good object. Of a singularly amiable and unassuming disposition, his movements were always transparent, but his sympathetic nature embraced everything that was good, as his upright soul shrank from all that was tainted. No citizen of Washington was more universally respected or deeply loved. None would be more sincerely mourned."

Telephone News from the Northwest.

[From the Minneapolis correspondent of the Western Electrician.]

Vermillion, S. D., has telephone connection over the Northwestern Telephone company's lines with the Twin Cities, Sioux City and other points. Yankton will soon be in connection.

The City Council of Sheboygan, Wis., has instructed the city attorney to proceed against the Wisconsin Telephone company to compel the removal of its poles and lines, as it has no franchise, while the local company has an exclusive franchise.

Andrew Stevens has been appointed manager of the Wisconsin Telephone company's office in Merrill, Wis., succeeding John Avery, who was transferred to Grand Rapids.

The Atlantic, Corning and Mt. Etna Telephone company has been incorporated to build a line from Atlantic, Ia., to Corning.

D. B. Foster of Fairchild, Wis., sought to prevent the Wisconsin Valley Telephone company from planting a pole in front of his house by chopping it down. The officers of the company say they will sue for damages.

Dell Rapids, S. D., now has connection with Sioux City, Ia., over the Northwestern Telephone Ex-

change company's system. Sioux Falls, S. D., is also on the line.

The Wisconsin Valley Telephone company is arranging to connect with Washburn, Wis.

Work has been begun on the telephone line of Rowe Brothers from Pierre to the Black Hills of South Dakota. It is expected to have the line completed by March 1st.

The Soo Line has put in a telephone exchange at Oakes, N. D. The patrons supplied the instruments, and the road furnished wire, poles and switchboard connection.

The Chippewa Falls, Wis., Telephone company has been incorporated with $25,000 capital stock. The new exchange will be in operation in a few weeks.

The Cedar Valley Telephone company is building a line from Waverly, Ia., to Nashua, in the same state.

The Mississippi Valley Telephone company of Keokuk, Ia., has been compelled by increasing business to order a 500 drop switchboard to replace the present one of 300 drops.

There are about 1,800 telephones in use in Sioux City, Ia. The Iowa Telephone company has 1,000 and the Home Telephone company 800 or more.

The Marquette County Telephone company has been compelled to put in a larger switchboard at Ishpeming, Mich. The company has 750 instruments in use in Ishpeming, Negaunee and Marquette.

The Wisconsin Telephone company announces a reduction of 50 cents per month at Ashland, Wis., where the Wisconsin Valley has made application for a franchise.

The American Telephone and Telegraph company has applied for a long-distance franchise at Winona, Minn.

Big Power Station at Niagara Falls.

The extension to the central power station of the Niagara Falls Power company has practically been completed on the outside, and, as shown in the accompanying picture, it is one of the most magnficent power stations to be found in the world. When this company erected the first section of its power house the style of architecture and general finish was very much admired. Its substantiality in all parts was impressive of the fact that the company was not building for a day or in any temporary manner, but, to use a popular expression, it was evident that it had come to stay. During the period of service the first section of the building has given satisfaction, so much so that the extension, which is twice as long as the original building, has been erected on exactly the same style of architecture and of the same material.

The length of the original section was 140 feet, and that of the addition is 286 feet, making the present length of the power house 426 feet. This length covers the entire wheel-pit and will afford ample room for installing the seven additional generators necessary to make the product of the station 50,000 horse power. This length covers 10 inlets, which afford a water supply for 10 turbines.

The 50-ton electric crane will run the entire length of the interior to assist in placing the machinery. Work on installing the fourth turbine and generator is now in progress.

Viewed from any side the building is of striking beauty. The outer surface is of limestone, and the inner walls for a height of six feet from the floor are of enameled brick, while above that point is ordinary brick coated with white enamel paint. The designs for the building, it will be recalled, were by McKim, Mead & White of New York.

Street Railways in Pennsylvania.

In the annual report of Major I. B. Brown, chief of the State Bureau of Railways of Pennsylvania, which has just been completed, the data upon the total capitalization shows that the amount of capital stock outstanding June 30, 1897, was $143,489,309; funded indebtedness, $42,812,430; current liabilities, $34,266,976, or a total capitalization of $220,568,715. Of capital stock and funded indebtedness outstanding the corporations themselves own $52,314,349. While there have not been many consolidations or mergers in law, yet practically there has been a large number of cases where traction companies, as authorized by law, have leased the lines of other street railway corporations upon a nominal rental, and the stock or a large portion of the stock of the leased company is assigned to the traction company, the stockholders taking in lieu thereof the stock of the traction company.

It is claimed that the great advance in the total capitalization during the last six or eight years is largely due to the fact that when a traction company takes charge of the lines by lease, merger or consolidation, the capitalization of the traction company is made usually two or three times as great as was the combined capital stock of the companies leased, merged or consolidated. By this process of controlling the lines of street railways in Pennsylvania, the stock capitalization per mile of road is increased to an amount far exceeding the average cost of steam railways and their equipment in the United States. Major Brown says it may not be improper to suggest that the process referred to is an effort by the management of the street railway enterprises to make them pay a dividend upon a much larger capitalization than fairness to the public would warrant. The total gross earnings from operations were $18,879,649; income from other sources, $8,516,840, or a total income of $27,396,489. The receipts have fallen off in a measurable degree from those of the previous year. Major Brown says:

"In all probability the use of the bicycle by business people and pleasure-seekers is the prolific source of the reduction in the receipts of many street railway companies. In cities where favorable conditions do not exist for the use of the bicycle, where the hills are steep and not easy of ascent or descent, the railway companies probably have not been affected by the use of the wheel to so great an extent, but in cities like Harrisburg and many others it cannot be gainsaid that the bicycle has become a most serious competitor of the railway."

To reinforce this view of the case an observation was made on Third street, Harrisburg, during the month of October, 1897. The observation covered two days from seven in the morning to six in the evening. During that time 6,078 persons passed a given point, 1,962 in the cars and 4,116 on bicycles; 67.7 per cent. on bicycles and 32.3 per cent. on the cars, or more than two to one in favor of the wheel. To what extent this large number of bicycle riders affected the receipts of the traction company can only be conjectured.

The total cost of road and equipment is reported to be $118,250,014, and Major Brown suggests that the disparity between these figures and the total capitalization of $220,568,715 is so great that it can be accounted for only in one way, and that is by the fictitious issue of stock and possibly of bonds.

The total of operating expenses is given at $10,075,644; taxes, $1,567,335; interest on funded debt, $1,919,084; rentals, $7,736,525; other expenses, $942,481; dividends, $5,214,874; a total of $27,455,943. If these figures are correct, then the disbursements have by a small amount exceeded the income during the year. The report shows that there are in the service of the street railways of Pennsylvania 4,914 motor cars and 499 other cars, or a total of 5,413, and that the number of employes is 12,079, to whom was paid during the year $6,920,692. The number of passengers carried is shown to be 409,723,418.

During the year there were 18 passengers killed and 519 injured. Grade crossings seem to have been responsible for many of the accidents.

BIG POWER STATION AT NIAGARA FALLS.

Specifications for Chicago Street Lighting Plants.

Controller Waller of Chicago, through City Electrician Ellicott, has issued the specifications for the engines, dynamos, lamps, wire, etc., which are to be purchased for the municipal arc lighting plant at the Sixty-eighth street pumping station. Proposals will be received at the controller's office in the city hall at 10 a. m., on December 22d.

Bids are solicited on three classes of engines—Corliss cross-compound, high-speed compound direct-connected to countershaft, and high-speed direct-connected to dynamos. All engines are to be run condensing. The Corliss type must be a vertical cross-compound belted engine of not less than 1,200 indicated horse power at one-quarter cut-off and 125 pounds steam pressure. The maximum speed allowed for this type is 100 revolutions per minute. Two engines, each of 600 horse power, will be needed, if the second, or vertical high-speed compound, type is selected. These engines are designed to be direct-connected to a countershaft by clutch couplings. The maximum speed for these engines is 250 revolutions per minute, with steam pressure as before. The third class of engines in contemplation is intended for direct connection to the dynamos. Ten would be required, each of 125 horse power. These engines, too, must be vertical, and the cross-compound type is required. A maximum speed of 460 revolutions per minute will be allowed. The successful bidder must set up his engine or engines within 90 days from the date of the contract, at Sixty-eighth street, under a forfeit of $25 a day after that time. Then he must operate it or them for a period not less than 30 nor more than 60 days until the tests are made. If the tests are satisfactory, payment will then be made in full. If not, the contractor will be given 30 days to correct the faults, and after that there is a forfeit of $10 a day to the purchaser until the engine or engines is made satisfactory.

Ten series arc dynamos of 150 lights capacity each are required. Ten ammeters are also mentioned in the dynamo specifications. Bids are asked for belt-driven machines and for dynamos arranged for direct connection. The normal current output must be 9.6 amperes and the maximum voltage 7,750. The speed must not exceed 650 revolutions per minute for belted dynamos or 460 revolutions per minute for direct-connected machines. The frame must be of soft cast-iron with wrought-iron pole-pieces. The field coils must be wound in the form of spools, easily removable from the cores. The armature must be a Gramme ring with removable coils and a core of laminated metal. No band wires are allowed. An automatic regulator is specified, and the commutator must be of the open type. A commercial efficiency not less than 87 per cent. at full load is to be guaranteed. The heating limits allowed are 75° F. above atmosphere in the armature; the same in field coils and frame, and 100° in bearings after a continuous run of 14 hours at half and full load. The dynamos must be capable of operating with a load of 10 lamps or an overload of 10 lamps, and the regulator must not require adjustment from no load to full load. The contractor is required to set up the dynamos and start them within 60 days from the date of the contract, under penalty of a daily forfeit of $25. The tests will be made within 10 days after dynamos are set up, and if satisfactory the machines will be accepted. If not, the contractor will be allowed 30 days to correct the faults. If the dynamos do not then comply with the requirements, they will be rejected.

The arc lamps required will be about 1,100 in number, of 2,000 nominal candle power each, with the same number of brackets and hoods. The lamps must be provided for single carbons capable of burning 14 hours. They are to be equipped with globes, globe holders and all attachments complete. The frame is to be of the single side-rod type, and the shells must be of polished and lacquered copper or brass. The lamps must feed between 48 and 53 volts, and the point of cut-off must not exceed 65 volts. A sample or design of the lamp, bracket and hood must be submitted with the bid.

About 246 miles of the best quality of weather-proof line wire will be required, half to be delivered at Sixty-eighth street and half at the Englewood Fire Alarm Office on Wentworth avenue, near Sixty-third street. It is to be of No. 6 B. & S. gauge. Bidders must state the weight per mile of wire, and a 50-foot sample must be submitted with the bid.

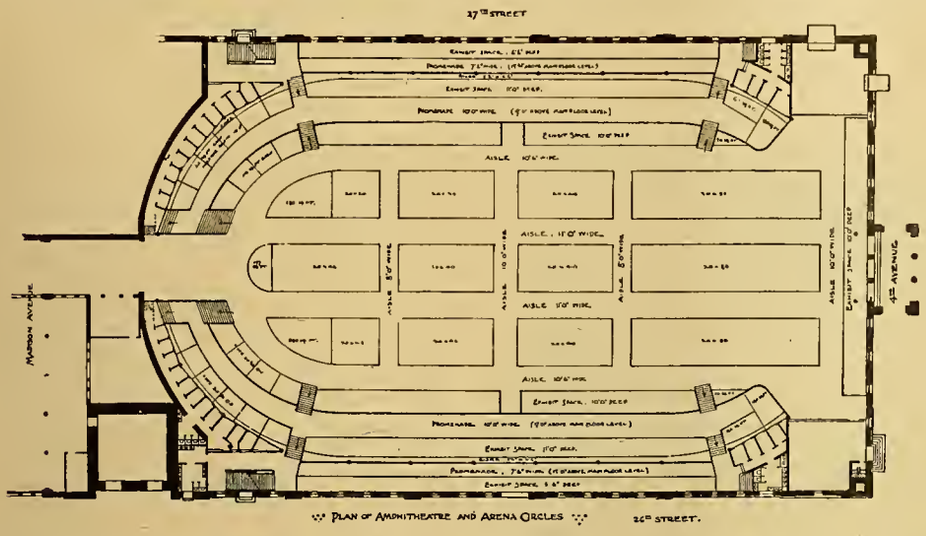
The poles are to be of cedar, 40 feet high and not less than seven inches in diameter at the top. They must be smoothly shaved and painted with one good priming coat of white lead and boiled oil. About 700 will be required. The other supplies include galvanized iron wire, 10,000 glass insulators, 9,000 locust pins, 1,500 cross-arms, etc.

All bids must be for a type of apparatus which has been in successful commercial operation for at least two years, and the usual bond for patent infringement, etc., must be given.

Electrical Exhibition.

An informal meeting of the officers of the Electrical Exhibition company of New York was held on Monday, December 6th, for the purpose of giving the promoters of the enterprise an opportunity to present their plans to representatives of the electrical press.

Hugh H. Harrison, chairman of the executive committee, explained that before the organization was formed there had been a large number of inquiries upon the subject of an electrical exhibition,



PLAN OF AMPHITHEATRE AND ARENA CIRCLES

ELECTRICAL EXHIBITION.

and the desire had been expressed that one be held in New York the coming spring. Mr. Harrison also said that upon hearing that no effort was being made in Chicago or elsewhere in the same line, it was decided to perfect the organization, which was done; and that in the short time that had ensued a great deal had been accomplished. Madison Square Garden had been leased for the month of May, 1898. This placed at the disposal of the company 35,000 square feet of floor space, and it is hoped that it will enable the management to avoid confusion and crowding. A floor will be laid covering the arena boxes, which will be nine feet above the cement floor of Madison Square Garden. A promenade will be arranged around the entire exhibition on this floor of 10 feet, and just above this will be an exhibit space of 11 feet. Mr. Harrison said that in the Electrical Exhibition held at the Grand Central Palace in May, 1896, there was used one battery of boilers of 600 horse power, and 12 different engines and dynamos, and at this early day the indications were that there would be three bateries of boilers and a very large increase in the operative exhibits of both engines and dynamos.

General Manager Marcus Nathan explained in detail the general arrangement of exhibits as shown in the accompanying illustrations, and added that at present there was sold one-third of the full amount of floor space that was occupied at the Grand Central Palace. Applications were being filed very rapidly, and desirable space would soon be a difficult thing to procure if the demand kept on the way it had during the past 10 days. It was pleasant to notice, he said, that among the first to send applications for space were those who exhibited a year ago, all being anxious for still larger assignments. Mr. Nathan also informed those present that especial attention would be given to securing novelties in the electrical line.

There were present Hugh H. Harrison, chairman of the executive committee; George F. Porter, secretary and treasurer; Marcus Nathan, general manager; C. A. Lieb of the board of directors; W. D. Weaver, American Electrician; C. W. Price, Electrical Review; T. C. Martin, Electrical Engineer; W. J. Johnston, Electrical World; W. T. Hunt, Electrical Age; W. F. Osborne, Western Electrician. Letters of regret were read from L. F. Requa and Charles D. Shain.

Electric Linemen Prevented from Cutting Trees.

An attempt of some linemen of the West End Electric Light company to mutilate fine shade trees in front of the Pardee residence, in Hazleton, Pa., was effectually checked by Miss Edith Pardee. These trees are especially dear to the Pardee family because they were planted 40 years ago by Ario Pardee, the founder of Pardee Hall at Lafayette College.

Some of the branches were in the way of the wires, and the men began to cut them. When Miss Pardee perceived this she called out to them from a second-story window to stop. They refused to do so, but the next moment the lineman who had made the refusal found himself looking into the barrel of a small pearl-handled pistol held by Miss Pardee.

"Stop cutting those trees at once," said Miss Pardee, "or you'll get hurt!"

"Oh, certainly," replied the lineman, and he slid down from his perch in a hurry. At last accounts no further spoliation of the trees had been attempted.

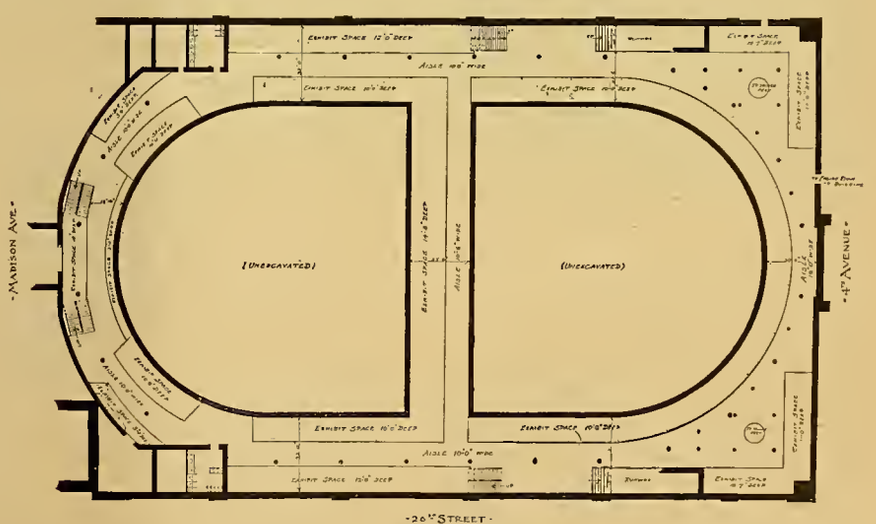
Formation of a Wire Trust.

It is generally admitted that a great wire trust is in course of formation.

Representatives of a majority of the steel wire, rod and nail manufacturers were in conference December 9th, relative to the pending scheme of consolidation of all their interests into one corporation. The meeting was held in New York and was attended by John W. Gates of the Consolidated Steel and Wire company, J. H. Parks and J. C. Pierson of Boston, Philip W. Moen, William E. Rice and Judge Dewey of the Washburn & Moen Manufacturing company, Worcester, Mass.; G. H. Ten-Broek and D. J. Wolff of St. Louis, George Oliver and H. T. Oliver of Pittsburg, the Chisholms of Cleveland, representning the Horse Power Nail company and the Cleveland Rolling Mill company; Frank Baackes of the Salem Wire Nail company, and I. L. Ellwood of the Ellwood Manufacturing company. It is understood that the whole scheme of consolidation is to be underwritten by the banking house of J. P. Morgan & Co. Three appraisers have been appointed, representing different parts of the country, to whom the estimates of each firm as to the value of its establishment have been submitted. The interests controlling some of these companies will sell out for cash, while others will take stock in the new corporation, which will be named the American Steel and Wire company. It will have a capital stock of $70,000,000, half common and half preferred. The initial steps have already been taken to obtain a charter under the laws of the state of New Jersey. Just when the consolidation will be completed is not known, but it is expected to be within the next two months.

A telegram from Providence says that the following eastern firms are among those to be taken into the new combination: The Ansonia Wire and Brass company of Ansonia, Conn.; the Bridgeport Brass company of Bridgeport, Conn.; the Benedict & Burnham Manufacturing company of Waterbury, Conn.; Coe Brass Manufacturing company of Ansonia and Torrington, Conn.; Holmes, Booth & Haydens of Waterbury, Conn.; the Taunton Copper Manufacturing company of Taunton, Mass.; the Seymour Manufacturing company of Seymour, Conn.; Washburn & Moen of Worcester, Mass.; J. A. Roebling of Trenton, N. J., and the American Electrical Works of Phillipsdale, R. I. The consolidation embraces the manufacturers of wire nails, barbed and roofing wire, and the countless form of screen and netting wire, in addition to that used for electrical and kindred purposes. In fact the plan is to secure the entire and absolute control of the wire manufacture of the country.

The first admission of importance is contained in the statement given out by Philip W. Moen, treasurer and general manager of the Washburn & Moen Manufacturing company: "No scheme looking to a trust in the proper use of the term has been under consideration, but for the purposes of economy in administration and in the manufacture of wire and wire products several of the larger manufacturers are proposing to form a new corporation, under the direction of J. P. Morgan & Co. of New York, to take over as going concerns several establishments that are engaged, some in mining ore and coal and the manufacture of steel and others in the manufacture of wire and wire products, with the expectation that most beneficial results will ensue, both to the manufacturers and to the buyers and consumers. The Washburn & Moen Manufacturing company has been approached with reference to the purchasing of the shares of the capital stock of this corporation at a price which will properly represent the value of the business conducted by it. It is quite possible that negotiations now going on may be concluded to this end within a few months. In this event, each shareholder may then look for an opportunity of receiving a price for his stock which will represent the value of the business conducted and the large surplus which has gradually been accumulating during the past 10 years. Should the sale eventuate, there will be no change in the continuance of the works under the present general management, but simply a transfer of the ownership of the shares."



PLAN OF BASEMENT OPERATIVE EXHIBITS

ELECTRICAL EXHIBITION.

Independent Telephone Movement in Michigan Copper Country.

[From the Daily Mining Journal, December 10th.]

The second meeting of the promoters of the Houghton County Telephone company was held Tuesday afternoon at the offices of Dunstan & Hanchette at Hancock. Reports were received from the committee appointed to investigate the question of the cost of telephone plants, the prices charged at other places by local telephone concerns, and other information touching upon the question. No further action was taken, and the books of the organization were placed in the hands of Messrs. Heidcamp and Grierson for further subscription.

The new company has met with considerable encouragement, which is offset by a serious drawback in being unable to secure recognition from any of the various mining and smelting companies, which is almost indispensable to its success. Both Messrs. Heidcamp and Hanchette stated this to be the situation, and should the affair be eventually dropped the latter says that it will be for this reason. The Houghton County Telephone company has accomplished, during its brief career, that which for some time has fallen upon deaf ears, viz.: A material reduction in the rates of the Michigan Telephone company, for which the community owes it a debt of gratitude.

Mr. Hanchette stated that since the reduction recently made by the Bell people some of the mining companies have made extended contracts at remarkably low prices, so that recognition to a local concern in these instances seems impossible for some time, at least. The disadvantage is apparent, when it is considered that the 'phone business at Atlantic, Quincy, Franklin, Dollar Bay, Wolverine, Centennial and it might be said South Lake Linden, is confined largely to the mining companies. The Calumet and Hecla company is averse to the proposition, having recently made a long contract with the Bell company, and objects to additional poles being erected on its property. The Tamarack, and also the entire Bigelow group of mines, it is stated, are in much the same position.

Storage Battery Road at Ostend.

The electric plant of the Ostend railway, according to l'Electricien, was established in the depot of the local railway. The line so operated has an extent of 3.1 kilometers, and is virtually a circular road, connecting the Kursal boulevard, Rogier station and the harbor.

The plant includes one compound engine direct-connected to a Westinghouse dynamo, generating 135 amperes at 280 volts, and operating at 650 revolutions.

The switchboard is of three white marble sections, with the usual instruments, and commands four accumulator-charging circuits, with pressures varying between 240 and 270 volts.

The charging of the accumulators is done upon a central track, so that the handling, both loading and unloading, is extremely easy of accomplishment.

STORAGE BATTERY ROAD AT OSTEND.—CHARGING STAND, ACCUMULATORS AND REFUSE TANK.

The complement of each car comprises 12 boxes of nine elements, having a capacity of 140 ampere-hours, at a 50-ampere rate. The charge lasts from three-quarters of an hour to two hours, according to the demand made upon the battery. As constant use gradually disintegrates the active matter of the positive plates, this is carefully saved in the tank C, in the picture of the accumulator room, and eventually used for renewing the battery. This process is several times repeated before the frame finally becomes worthless, when it is recast.

Each element is contained in an ebonite vessel, the nine elements being inclosed in a wooden trough, having two bands of copper for contacts.

The carriages weigh 7,500 kilogrammes without accumulators or passengers, and have a capacity of 24 seats and 26 standing places. They have no imperial or deck seats.

The carriages are lighted by six 16-candle power lamps each, and are provided with two 18 kilowatt Westinghouse motors, each direct-connected to an axle by reducing gears of one to five.

The motors are regulated by a series-parallel commutator with spark extinguisher.

According to data obtained for three months of active service, the management claims that the expense of this line will be very much below anything so far known in this form of traction, the consumption of coal being shown to be but 1.45 kilogrammes per kilometer-car.

Power from the Whirlpool Rapids.

[From the Toronto Globe.]

The discussion of the power question has arrived at that stage where the City Council might very well open up negotiations with other municipalities with the object of discovering whether the cost to each of electric energy might not be greatly lessened by the co-operation of all in a comprehensive project.

The Board of Trade of Niagara Falls asks that the city engineer investigate their proposal for the generation of power from the Whirlpool Rapids, claiming that an unlimited quantity can he obtained at $12 per horse power. Hamilton is negotiating for cheap electric energy, and all over the country between Toronto and the Falls electric railways are springing up, which would be greatly benefited by power at the lowest possible price. There are two routes by which Niagara power may be brought to Toronto; the first and most direct by cable across the lake, the second by overhead wire around the end of the lake, passing en route Hamilton, Oakville, and other places, where power could be largely used. The second route would involve twice the mileage of the first mentioned, and would doubtless be very much more costly at the outset, but it would be less liable to disturbance and breakdown than the cable, which would, of course, become useless the moment the insulation was penetrated at any one spot. The question of routes and of comparative economy is one for experts, however, and should be referred to them for a comprehensive report.

Electricity on Shipboard.

George W. Dickie, manager of the Union Iron Works of San Francisco, under whose supervision several of the new warships were built, read an interesting paper before the recent meeting of the American Society of Mechanical Engineers in New York, in which he compared the merits of the several methods now employed in transmitting power on war vessels.

"Unfortunately," Mr. Dickie says, "on government vessels the work which has to be done by machinery is divided up and placed under the cognizance of various bureaus, each having a decided preference for some particular mode of transmitting power which might really be the best for the particular work of that bureau, but not applicable at all to the class of work under the cognizance of another bureau, the result being that in one ship we are very likely to find three different methods of transmitting power in use, and no one in charge master of any one method."

Concerning the general and special applications of electricity to ship service, Mr. Dickie says:

"Electric power is generated for lighting purposes, for controllng searchlights, operating small fans for special purposes, and for signal purposes. In quite a large number of vessels electric power is used to operate ammunition hoists, and in one or two recent cases the lighter turrets have been operated by electric motors. In some vessels now building a further extension of electric transmission of power is being made to include the large turrets and all the gun mount movements of the large guns, so that we now have the Ordnance Bureau fairly committed to this method of transmission. In some of our ships the distribution of power is divided between electric and hydraulic transmission, the main battery being operated, including the turrets, by hydraulic power, while the ammunition for all secondary guns is served by electric hoists."

The difficulty of making a fair and comprehensive comparison of the several methods is recognized by the writer. "In the present state of the art of transmitting power to all parts of a modern warship it is not possible to compare one method with another as a whole and from actual experience, there being no one ship with a complete system of transmission from a central generating station of one type to compare with another ship having an equally complete system from a central generating station of another type." Mr. Dickie assumes that all the operations requiring power on a warship can, through properly designed machinery, be performed by steam sent direct from the boilers, water under pressure, compressed air or electricity.

One of the greatest disadvantages of using steam for all power purposes is thus considered: "The presence of steam pipes in all compartments of a war vessel must be considered in connection with the business in which the vessel is to be engaged, and that is to fight. It would be difficult to overestimate the loss which migh result from a broken steam pipe in any compartment under the main deck of a war vessel in action. Such an accident might not only involve the loss of all men in such a compartment, but the total disablement of the ship as a fighting machine." Then Mr. Dickie speaks of the heat which steam pipes and engines must of necessity give off, and says that it is difficult to see how under exposure to this heat men can be expected to perform all of the duties of the under-deck force in time of action.

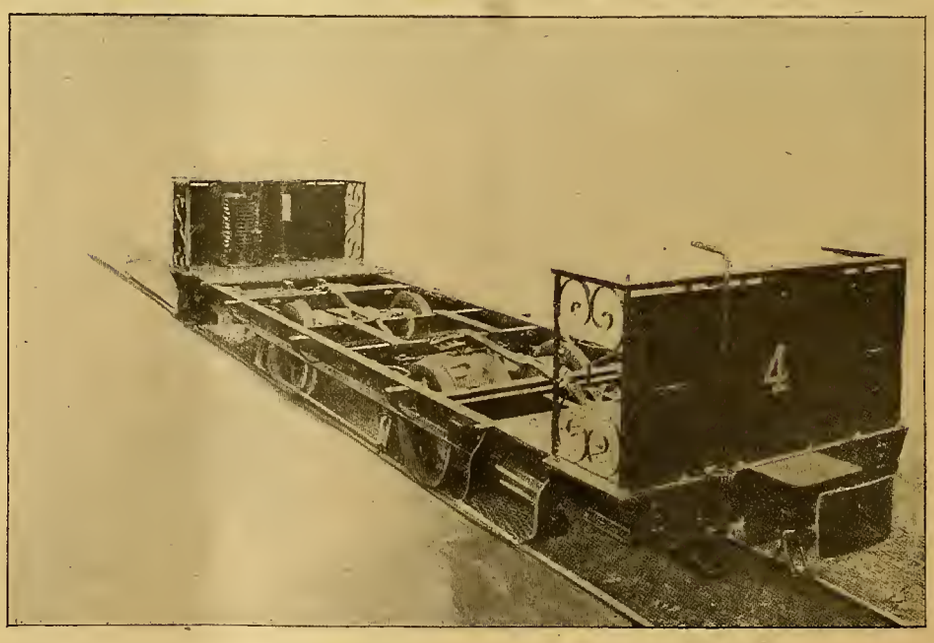
It is admitted that electricity has many features to commend it. One of its advantages is that it is now the fashionable agent for power distribution, and the electric installation would be likely to receive more intelligent care and more skillful application than any other. The economy of the system Mr. Dickie grants, and the ease with which electric wires can be carried through a ship is admitted to to be an important advantage over every other method of transmitting power. Two features, however, he questions. He says:

"We might safely take it for granted that whatever disturbance would fracture pipes of an air or water system would part the wires of an electric system. In that case the danger to life and also to the ship would be far greater with the electric system than with the others. Automatic safeties could be applied to almost any conceivable extent against such accidents, yet, where safety devices are needed, the system cannot be so safe as where no safety devices are needed.

"There is also a growing fear among marine engineers that certain materials are rapidly destroyed by electric action, caused by the hull of the vessel become magnetized in some way, the nature of which is not yet fully understood. It is claimed that vessels fitted with electric generators develop rapid deterioration in all sea-water pipe connections. Whether sufficient reliable data have been collected, either to establish or refute this claim is, we think, doubtful. It is a question which, we think, ought to be most fully investigated. At present it is simply a matter of conjecture, and, to marine engineers, a matter of uneasiness."

Throughout the paper Mr. Dickie earnestly advocates the use of compressed air, although he disclaims any such intention, and in conclusion says:

"This paper does not aim to show the superiority of any one system over another, the comparisons made being simply to show that there is no mechanical difficulty in operating all auxiliaries by any one of the systems herein mentioned and to express a hope that our government would either adopt some one system and carry it out complete, developing that system to its utmost efficiency, or else take one or two similar ships and fit them with power transmission systems completely representing different agents—say one electric, one hydraulic and one compressed air. Let each be placed for three years in the hands of officers heartily in favor of the system in use on their own ship, and thereby obtain



STORAGE BATTERY ROAD AT OSTEND.—TRUCK.

a practical demonstration of the very best points in each system.

"While we have hitherto advocated with all the ability we possess a complete hydraulic system, our experience in the practical working of hydraulics on shipboard has not been of the most pleasant character. Officers are required to care for and get the best out of a hydraulic system, while personally they would rather sit up all night with an electric plant than spend a moment more than the law requires with a water motor. The future hopes of the young officer are centered in electricity, and he devotes himself to it with a will; and so long as that condition prevails, the electric method of transmission will have the best chance to succeed, because with that it has a flexibility and a general adaptability which the other systems do not in themselves possess."

Laundry in Street Railway Plant.

Economy in the management of large street railway properties has made necessary many changes from the crude methods that obtained in the days of the old horse-car lines, before the substitution of electricity for animal power and the extension of the service and establishment of the network of electric trolley lines that can now be found in all large cities. One of the latest innovations in this class that has been introduced into the service of the Chicago City Railway company is the equipment of a laundry in the shops on Dearborn street, at the rear of the company's power house and office building. A large washing machine and wringer have already been placed in position, and an ironing room is now being fitted up. The principal work of this laundry is the washing of curtains used on the open summer cars and the towels used by the office force and conductors.

The company had 800 open cars in service last summer and as there are 14 curtains to each car it will be seen that at the close of the season, when the cars were withdrawn from service, there were 11,200 soiled curtains to be washed and ironed.

In former years the washing alone of these curtains kept four men busy all winter, and the results were far from satisfactory. The curtains were spread out on a table or bench, and the men scrubbed them with brushes. This proved a very costly method, and as the number of cars in service increased each year and the number of curtains grew correspondingly larger, the problem became quite serious, and the master mechanic of the company, C. E. Moore, was called upon to devise some method by which the washing could be done by machine. It was found that the washing machines on the market were not suited for the purpose, and it became necessary to design one to meet the requirements of this special work. The present equipment is the invention of Mr. Moore, and in service it has proved satisfactory in every respect.

As shown in the accompanying picture of the plant, the machine comprises a barrel-shaped receptacle for the articles to be washed, revolved upon an axle supported by a frame. At one side is arranged the driving mechanism. This includes three pulleys, the middle one being connected to the axle which turns the machine and belted to a shaft overhead when it is desired to operate.

A reversing mechanism, designed by Mr. Moore, automatically changes the direction of travel and secures uniformity in the number of turns each way. This last feature is necessary in order to prevent the curtains from being rolled into a ball, as they would be if absolute accuracy was not obtained in the number of revolutions before each reversal.

The capacity of the machine is 42 curtains, those of standard weight requiring 30 minutes and those of lighter material 20 minutes. Ten minutes is allowed for rinsing. This is done by draining off the water in which the curtains were washed and turning on a supply of cold water. The supply of hot and cold water is brought directly to the machines by feed-pipes. After the rinsing process the curtains are taken out and put through a wringing machine. The work requires only part of one man's time.

An ingenious electric time-signaling device is arranged to warn him when his attention is required. This comprises a clock, with an extra metallic rim around its face, a plug, two primary batteries connected to the clock mechanism and the metallic rim, and an electric bell. This device is shown in the cut. There are 12 holes in the metallic rim corresponding to the hours on the dial. When the attendant "charges" his washing machine, say at seven o'clock in the morning, he puts the plug in the hole below six, and at 7:30 o'clock the bell will ring to notify him that time is up. A metallic extension of the minute hand makes contact with the plug and completes the circuit while the hand is passing the point. The plug can then be advanced two holes, and in 10 minutes another warning will be sounded, notifying the attendant that the time allowed for rinsing has expired. By this means uniformity is secured and the best possible results are obtained from the machine.

The plant is also used for washing towels, as already mentioned. Formerly the company sent out its towels and paid $40 a month for washing them. With the present equipment it is estimated that a saving of $30 a month can be effected in this item alone.

In addition to the economical features of the equipment, these labor-saving devices have relieved the force of great deal of drudgery, and in other ways it is proving equally satisfactory.

Three-wire Practice in England and America.[1]

By Harold Lomas.

The "three-wire system" was to all intents and purposes simultaneously and independently invented by Edison in America and Dr. John Hopkinson in this country.

In America Edison companies were formed, and we thus have companies bearing this name in New York, Philadelphia, Chicago and Boston, which, working on the most thorough lines, are gradually, in the different cities in which they exist, absorbing and converting to their own uses all rival companies; thus their systems are of enormous magnitude. For instance, the New York Edison company has no fewer than five three-wire generating stations, as well as a battery sub-station, all linked together by feeders, so as to reinforce one another according to the load distribution. The service attached to the mains amounted at the end of 1896 to an equivalent of 540,342 16 candle power lamps.

In England we have no three-wire stations that will compare from point of output, and the independent development of the system in two countries has led to many differences of detail, some of which are due to the immense disparity in size.

Considering the generating plant, first the type of engine or dynamo employed for any particular service is to a large extent influenced by the size required. The advantages of direct driving have long ago been recognized for electric lighting purposes, and this once settled, the requirements of engine and dynamo each tend to modify the other. The modern practice in the States tends to a vertical slow-speed engine of the marine type.

In the great Duane street station, the most modern development of the New York Edison company, we find two-crank quadruple expansion engines (two cylinders in tandem on each crank) of 2,500 horse power. So great is the space economy of this arrangement that power is generated at the rate of a horse power for each half square foot of engine floor. In Chicago three-crank triple expansion engines of the same type are used, with one cylinder to each crank. In both cases the generators are carried on extensions of the shaft, without an outside bearing, serving as fly-wheels in addition to their other duties. In England the high-speed engine has attained a popularity it has never reached on the other side of the water; the value of the Willans engine, both from point of view of its economy as a steam user and the small space it requires, is too well known to require more than mention.

As regards generators, the large output of the American demand a multipolar design, and though two-pole machines are almost invariably used here for small outputs, the advantages of the multipolar machine in larger sizes are fully recognized.

In the combined sets there is, however, this difference, that whereas in America each set forms in itself a three-wire unit, here it is quite as usual to have one or two balancing machines connected between the positive and neutral and neutral and negative respectively, and all the others connected across the "outers," that is to say, for the same output the Americans build two dynamos, each of half the output, to our one of the whole output.

On the other hand, they use their dynamos as fly-wheels and do not require an outside bearing, while we must have at least one three-wire unit or two complete sets giving the voltage between the outer and neutral wires. As regards switchboards and mains, in the most modern American practice all the mains within the station are fireproof, and at the switchboard itself copper of the highest conductivity is used throughout, even down to studs and nuts.

The now universally used Weston shunt ammeter is the natural outcome of the use of large currents, and the edgewise ammeter helps to make a very compact board. The practice of running at several potentials is, of course, incidental to the supply of a large area. The Edison tubing used for the mains consist of drawing in the three mains insulated with jute into iron pipes cast in lengths of 20 feet; a non-conducting compound is then forced in, effectually insulating the mains from each other and the pipe. This makes an exceedingly good piece of work, and breakdowns are rare, but repair is difficult.

The neutral is purposely grounded, the idea being that if a short-circuit does occur, it will not have the full voltage of the "outers."

This grounding of the neutral is quite out of the question where bare copper mains are laid, as in some English practice, because after some working the resistance of the negative to earth becomes very low.

On the question of working costs the American, quite unusually we admit, is very reticent; direct comparison is, however, impossible, first because their rate of wages is so much higher, and secondly, they always include in their working costs the price of renewing, testing and trimming lamps, both arc and incandescent.

The popularity of the "three-wire" system in the United Kingdom is rather marked, there being about 30 stations so equipped, and it is pleasing to be able to record that in the matter of electric lighting generally we can fairly hold our own with the American.

The question of combined lighting and traction plants is very much before the English engineer now; as yet it has not been tried on a large scale, and it is too early to get results from Dover, where an alternating lighting station supplies a part of the current for the trams by means of a motor-generator, but this much may be said, that a lighting plant on the three-wire system with 500 volts across the "outers" offers the most facilities and might, under special circumstances, be advantageously combined with a traction plant. At any rate, in selecting a system this point is worth the consideration of any corporation proposing to install electric light, and it is the bounden duty of every corporation to equip its city with electric trams.

1. From the London Electrical Review.

LAUNDRY IN STREET RAILWAY PLANT.

The receipts of the Calumet Electric company for November were reported to be $2,000 ahead of the same month last year.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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State of Illinois, County of Cook—ss:

Thomas Jansen, being duly sworn, deposes and says that he is a resident of the city of Chicago, in the county of Cook and state of Illinois, and that he is the foreman of the printing department of the Electrician Publishing company, the publishers of the Western Electrician; that he was present at and superintended the printing of No. 24 of Vol. 20 of the Western Electrician, issued on June 12, 1897, and that there were printed by actual count 20,000 complete copies of said Western Electrician of the volume and number above specified. And further this affiant sayeth not.

THOMAS JANSEN.

Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

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Issue	Number of Advertising Pages.	Whole Number of Pages.	Square Inches of Paid Advertising Matter.
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February 23, 1895.	52	68	5,593
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Further evidence of the necessity of providing improved braking facilities upon street railway cars is furnished in the recent accident on the North Hudson County line approaching the Hoboken ferry. Street railway managers owe it to themselves to find some means of improving this department of the service.

The date for the sixth annual convention of the Northwestern Electrical association has been fixed, and other arrangements are in progress. The meeting will be held at Milwaukee on January 19th, and will continue three days. These gatherings have come to be recognized as the most important meetings of the electrical fraternity of the Northwest, and it is anticipated that the Milwaukee convention will be in keeping with the record of the organization.

There is a deal of balderdash in the statements of professional advocates of governmental control of the telegraph and similar public enterprises. Here is a sample of the spread-eagle oratory that delighted the members of the Single Tax club of Chicago at a recent meeting:

One giant corporation has the American nation by the throat and colors its commercial reports to suit the selfish ends of greedy monopolists and mere money makers.

The greatest of all public utilities should be run by the nation. It is monstrous for the private and personal business of the citizen—his telegrams, which are generally more important than even his mail—should be submitted to the espionage of employes of a monopoly.

Of course such utterances only serve to bring the cause advocated by the organization into disfavor, among men of intelligence, but there are many persons who do not discriminate between the wild utterances of a man looking for a government job or a man with a grievance, and those who give economic questions careful consideration. It is to be regretted that an organization containing so many able and really brilliant men as the Single Tax club should furnish the means of sending forth such rot as here quoted.

In considering the "Polarization Capacities of Membranes," G. P. Grimaldi and G. Platania investigated the polarization of a voltameter containing a thin metallic membrane by means of a pendulum interrupter enabling them to charge it for a very short and precisely determined interval. They used films and plates of gold, that metal being particularly suitable on account of its malleability and its slight tendency to occlude gases. The London Electrician says that the experiments brought out the important influence of duration of charge upon the polarization capacity, that being invariably greater in the case of films than in the case of plates when the charging time was very short. As the time increased the difference in the behavior of plates and films decreased, and eventually reached zero. After that point, however, a difference in the opposite sense set in, the polarization capacity of the plates becoming greater. The shortest time interval obtained was .001 second. The neutral point set in about .3 second. The explanation of these facts is to be sought in the penetration of the charges—the diffusion of ions into the interior of the electrodes. The experiments show that the charge traverses the whole thickness of the gold film in a very short time.

The Philadelphia Inquirer enters a protest against agitations to restore the graves of eminent people. Taking for its text a recent statement that Benjamin Franklin's grave is in a state of neglect, it says: "There never was anything the matter with Franklin's grave, and there isn't to-day, except, perhaps, in the minds of those persons who think that the modern cemetery is an ideal of beauty, and who imagine that something essentially pretentious, huge and modern in marble would be a suitable thing to place over the grave of a century ago. Franklin's grave is just as it should be, in keeping with its time and the tastes and simple personal habits of the Philadelphia printer and statesman."

We are glad to receive this assurance that Dr. Franklin's grave has not been neglected, and we believe the electrical fraternity generally will favor the idea of respecting the wish of the great scientist to avoid all ostentation and display. But we believe that too much respect cannot be paid the memory of the great American philosopher, statesman and scientist, and that much good may come from impressing the lessons of his life upon the present generation. Dr. Franklin was a fine old man with a high sense of duty, and if his ideas of responsibilities of citizenship can be kept prominently before the people by shafts of marble or other memorials, they should be erected everywhere throughout the land.

Few applications of electric power have more general interest than the utilization of electricity in the operation of elevators. The growing importance of this branch is recognized in the effort that is now being made to overcome mechanical and electrical difficulties. That the engineering fraternity appreciates the situation is apparent. Mr. Moses' article on "Standards of Practice in Electric Elevator Installation" is a valuable contribution on the present condition of the art. The safety of this type of elevator is emphasized by the writer, and its efficiency and convenience are, in his estimation, clearly proven by the remarkable increase in the number of installations recently made. There is one point, however, upon which Mr. Moses is mistaken. It may be true that the establishment of the elevated railroads in New York led to the erection of the high buildings that have recently been put up in that town, and thus created a demand for high-speed elevators, but the conditions in Chicago were different. The sky-scrapers of this city preceded the building of the elevated roads; in fact, they made the latter necessary, as the congestion of traffic in the down-town district had become so great during the rush hours that the surface roads could not handle it. However, the dependence of one on the other is established in both cases. First-class transportation facilities are absolutely necessary where sky-scrapers are the rule, and where elevators are needed at all the advantages of the electric system command the attention of architects and builders.

Since the World's Fair so well demonstrated the capabilities of Americans as builders of electrical pleasure craft, a new department of our export trade has been opened, which, though not of great extent, is of exceptional interest. This is the building of electrical boats for foreign owners. It will be remembered that a number of the electrical launches which were so successful on the lagoons in Jackson Park were afterward shipped to Venice, where they vied with the time-honored gondolas for popular favor. Some of the men connected with the building and operation of the fleet of electrical boats at the exposition in Chicago formed a company to engage in the business of furnishing such boats, and they have sent several specimens of their work abroad on special order. Two recent instances are noteworthy, one order being from the czar of Russia and the other from Baron Nathaniel de Rothschild. The czar's boat is now building, while the other was shipped to Trieste last week on a Mediterranean steamer. The Russian monarch's gig will be 37 feet over all, with a freeboard amidships of two feet four inches. It is made to be hoisted into the davits of a large steam yacht, and its hull below the water-line will be covered with sheet brass. The deck fittings will be of brass casting, in some places nickeled, and the boat will carry a folding anchor, with a manila rope cable, and three lights at night. The batteries, motor and gearing will be entirely concealed from sight under the velvet-carpeted flooring and side seats. The latter are to be upholstered in dark-blue Russia leather. The cells are encased in hard-rubber shells and are connected to give a working potential of 110 volts. The order calls for a speed of eight miles an hour for three hours, or for seven miles an hour for six hours. An awning of white and blue will be arranged so that the operator in the after-cockpit can tilt it in any direction. The czar will probably have this craft in use by the middle of next May, as it will be ready for delivery before April 15th. All told, the little vessel will be the most complete specimen of its class ever shipped from the country. However, the launch which has been purchased by Baron de Rothschild is scarcely less elegant, although smaller. It will be used with the owner's steam yacht, the Veglia. It is 25 feet long, with 6½-foot beam, but is expected to go nearly as fast as the imperial vessel, the contract speed being 6.8 miles an hour for four hours, and 6¼ miles an hour for six hours. This boat is built of mahogany. It is hoped that it and the czar's launch will serve to bring additional orders to America.

Indianapolis Street Railway Litigation.

The decision of the United States Circuit Court of Appeals dismissing the appeal in the case involving the constitutionality of the three-cent street-car fare law passed by the last Legislature of Indiana was handed down at Indianapolis on December 10th. Among the attorneys for the company was ex-President Harrison, who appeared in all stages of the case before Judge Showalter when it was argued here last spring, and in his decisions Judge Showalter followed very closely the line of argument pursued by the ex-president. The decision does not affect the status of the parties, as the court simply decided that it did not have jurisdiction of the appeal. Within two or three months the case will be sent to the United States Supreme Court, where it will be tried on its merits.

It will be recalled that the Indiana Legislature at its late session passed an act providing that in all cities of over 100,000 population the fares on street railway cars should not be over three cents for each passenger. Indianapolis, the only city in the state which answers the description as indicated by the number of its inhabitants, attempted to enforce this law in regulating the management of street railways. In a proper suit in the local courts the validity of the state law was sustained, and on appeal to the state Supreme Court this decision was affirmed. It appeared as if Indianapolis was about to realize the benefits of a cheap-fare system, but at this point the Central Trust company of New York, a financial institution which held $3,000,000 of the bonds of the Citizens' Street Railway company, interfered. An injunction was secured from Judge Showalter of the United States Circuit Court to prohibit the city of Indianapolis from enforcing the three-cent fare law. On a motion to dissolve this injunction it was argued before Judge Showalter that it was the universal rule for the federal courts to follow the decision of the state supreme courts in the construction of state laws. He refused the motion, and from this decision the appeal was taken to the Court of Appeals.

The two vital points in the case are these: First, Was the three-cent fare act a violation of the charter contract between the state and the railway company? Second, Was the act of the state Legislature in applying the three-cent fare act to cities of over 100,000 inhabitants—Indianapolis being the only city of that description—such special legislation as the constitution of Indiana prohibits? These questions are intricately involved with each other.

To these is added a third question: Shall the federal courts in all instances follow the decisions of the highest state courts in the construction of state constitutions and laws?

The Court of Appeals simply dismisses the appeal of the city of Indianapolis from Judge Showalter's decision. Apparently it is on the ground of lack of jurisdiction. It is said that Judge Showalter had jurisdiction to decide the case of his own injunction. The appeal, therefore, should be directly to the Supreme Court of the United States.

But Judge Woods, in delivering the opinion of the Court of Appeals, argues some of the questions in a way adverse to the claim of the city of Indianapolis. He intimates that, in his opinion, the three-cent fare act violates a contract, and that an act of the Legislature applying to cities of over 100,000 population—when there is but one such city in the state—is as clearly special legislation as if the city had been designated by name.

As has already been pointed out, this makes the case of superior interest in Chicago and in all the legislation of Illinois relating to this city. Many of the statutes are in the form of legislation that will apply to no other city in the state. Are these such "general" laws as the constitution requires?

The state Supreme Court has sustained most of these laws where the question was raised. But at some time the question will go before the Supreme Court of the United States, and if that tribunal should refuse to follow the state court a vast amount of legislation on which the most important interests rest and on which municipal credit is based would be swept away.

Taxation of Street Railways in Massachusetts.

Everett W. Burdett, counsel for the Massachusetts Street Railway association, appeared before the special commission on street railways, by special assignment, on December 3d, to submit his closing arguments for the railways of the commonwealth. With this final statement the special commission closed the series of public hearings, and it will now devote itself to the preparation of its report on the relations existing between the municipalities and the railways of the commonwealth. Mr. Burdett announced that he represented companies whose aggregate investment in the business amounted to more than $50,000,000. The only real foundation for the claim that these particular users of highways should be subjected to special and peculiar taxes, he said, came from the alleged fact that they involve large charges upon municipalities to meet the extra cost for the care, repair and maintenance of highways. His claim was that if street railways had, in fact, increased the cost of road maintenance, they made ample returns to the municipalities in several ways, principally in the form of direct taxaton. The companies have also made enormous contributions to the public in the way of paving, road widening and grading, bridge building, removal of snow and ice, etc., and Mr. Burdette submitted a table of the cost of these items to five roads, exclusive of the West End, taken at random, from which it appeared that they had already invested considerably more than $1,000,000 in the item of paving alone. The roads have made other and less direct, but none the less valuable, contributions to the public in the increase of valuations which have followed their introduction and extension, which comparative results show to be practically gratuitous contributions to the public. Mr. Burdett claimed that whatever might be the theoretical demands of the case, as a matter of fact the companies could not afford to pay more in the way of direct taxation than they were now paying. The average rate of dividends for the last 10 years has scarcely increased at all, while the percentage of surplus to capital has steadily fallen from 15.01 per cent. in 1886 to 1.66 per cent. in 1896, and this decline has been most rapid since the introduction of electric traction. The claim for a reduction of fares, he said, was without support. In no other form, except perhaps for postage, can one obtain so much for a given amount of money as on the street railways of to-day. The American system of one fare for an indeterminate ride is distinctly in the interests of the general public. He said that eight per cent. upon the par value of existing capital is as little as ought to be fixed upon as the share belonging to the stockholders before division with the public.

American Machinery in Great Britain.[1]

That of late a considerable quantity of American electrical machinery has been supplied to the order of British customers is well known. That in some special branches the American manufacturer is in possession of greater experience, and therefore knowledge, than the British manufacturer, is admitted. But that American traction plants should find a market in Great Britain in competition with British production would appear to be the cause of much heart-burning, and occasionally of not a little display of acerbity on the part of some who feel that their own work is being ousted. It is perhaps but natural that this feeling should be given expression to, for, after all, human nature finds it difficult to rise above the common lines, which are more or less selfish ones—rather more than less as a rule. British human nature is apt, too, to be of a somewhat pronounced and sturdy type. While the claim is made that love of the principle "Fair play and may the best win" is an innate national characteristic, yet it may be observed that there are some who reserve to themselves the privilege of "glorious inconsistency," as witness what occurs upon almost every occasion when the American competitor scores over his British opponents in tendering for electrical traction and other contracts. A wail of indignation and resentment arises from the disappointed ones, which, were it but based on just and business-like grounds, would be worthy of serious consideration. But what are the reasons behind his action? Does the British manufacturer decry the use of plant from across the Atlantic because it is of poorer and less efficient design than that made by himself, or because it has less skill and high-class workmanship embodied in it than his own has? Well, no, not now; the days when such reflections could be uttered are past, for the very excellent reason that every British order filled by American manufacturers has been a practical refutation of such bogus charges. American machinery has been and is subject to the same tests prior to its acceptance; it has equally severe working conditions to contend with, and in addition is saddled with a far greater expense in transportation than is the case with British plant. In the face of this it competes, and that successfully, with all comers. Nor is it made by cheap labor; the American mechanic receives a high rate of wages, which is still high when compared with the cost of living. The British manufacturer, who either cannot or will not be induced to study the raison d'être of these facts, and, hating to see his own wares being supplanted, falls back upon sentiment for a battle-cry. He appeals to the public to support "home industries," to give "employment to British labor," and so forth. But all the time he continues to offer an article that is becoming obsolete, or that is more or less crude, and if reproached on the former head, he, in effect, replies that it is as efficient as any that can be made, while in regard to the latter his answer is that he is not to blame because the public will only afford him limited opportunities for manufacturing this semi-developed apparatus. It is but just to say here that the British nation is about the most obstinately conservative one in all Christendom, so there is some show of reason for the fact that the electrical manufacturer of the country has not aided to any great extent in the perfecting of traction systems. It is very evident that since the people have resolutely objected to the introduction of up-to-date methods until quite recently, often bringing forward ridiculous reasons to sustain their attitude of hostility, the manufacturers could hardly be expected to acquire much experience in such work.

Now that the public opinion has been, with great effort (put forth almost entirely by American, not British firms), swayed to the other side, and electric traction made to boom, it is nothing more than just and equitable that those manufacturers who have so largely helped to develop the knowledge of the subject in other countries should reap some of the fruits of their labors in this, which is commencing to avail itself of the pioneer work done elsewhere. But evidently some British manufacturers cannot see the fairness of this, because, doubtless, from their point of view, "the boot is on the wrong foot." When the steam engine was made a commercial success, British engineers offered no objection whatever to the filling of orders from foreign countries. And the same in the case of the locomotive. At the present day they are happy to send such plant abroad as they are paid for, even to countries that could themselves manufacture it. When it so happens, however, that certain branches of electrical work are, at great expenditure of money and energy, perfected outside of Great Britain, and when those who are responsible for this advance are given British orders to execute, there goes up a dog-in-the-manger cry, the motives of which are only too apparent.

The truth underlying the whole matter is not difficult to point out. Given a public notoriously conservative on the one hand, and, to a certain extent, bound up in vested interests on the other, it can be readily understood that the advantages offered by electrical science will not gain a very rapid headway. These characteristics will, nevertheless, operate to insure permanency in any progress that is made. Clearly, then, it would have been good business for the British manufacturer to have striven, in season and out, to win over the public to a thorough appreciation of the benefits awaiting acceptance, and in so doing he would have created the opportunities for enlarging his own experience. Instead of throwing himself, heart and soul, into a propaganda of this nature, he has been content to proceed along in a leisurely and very dignified manner, with the inevitable result that others elsewhere have seen their opportunity, and, being of hustling, business-like habits, have not been slow to grasp it.

Then again, although the British manufacturer has the advantage of low wages, cheap material and very short distances of transportation, he either cannot or will not sell his goods on a level wih his American rival. From this fact it is justifiable to infer one of two alternatives; either that an unduly large profit is looked for, or that the workshop management is of a low order.

To sum up the conclusions rendered apparent by the foregoing, it may be concisely stated that the manufacturer of American plant is entitled to the support he is receiving in Great Britain (not to mention the British colonies) because he has very largely been the perfector of the highest and most satisfactory types of apparatus for traction and power purposes; because he has convinced the British public of the backward state of its urban and suburban transit facilities; because he has gained a knowledge and experience in the working of the most modern and satisfactory system of traction known, that few can equal, and finally, because he competes for this support under the condition which has for generations past been entwined into British business life: the purchase (other things being equal) in the cheapest market.

1. From the London Electrical Review.

Objections to Coast Searchlights.

The plan to establish at Barnegat the electric searchlight purchased from France which was shown at Chicago during the World's Fair and which is now being tested at Tompkinsville, Staten Island, will probably be abandoned by the Lighthouse Board, in deference to the opinion of experienced mariners. Such lights have been in practical use on the north and west coasts of France and Germany for several years, and it was thought that the installation of one on the New Jersey shore would prove of great advantage in bad weather to both transatlantic and coastwise vessels bound for New York which were deterred from approaching too near Sandy Hook in heavy gales and storms. It is known that the great light which the lighthouse establishment owns would give warning of its presence at least 50 miles out at sea, while the present apparatus at Barnegat is visible only 19 nautical miles, and that at Navesink only 21 miles, the greatest radius of visibility of all lights on the coast.

The Gironde River entrance light on the west coast of France is clearly seen 21 miles, but its "luminous range of visibility" is 56 miles, and a little further north the Belle Isle light has a luminous range of 54 miles, its intensity varying according to atmospheric conditions. A similar light near Cherbourg, directly visible for 22 miles, has a luminous range of 50 miles, and there are several others of like power along the channel.

Captain Robley D. Evans, who commanded the New York at the Kiel review, taking that vessel on a considerable cruise through northern European waters, had experience with these great lights, and now, as a member of the Lighthouse Board, he will probably prevent their adoption in this country. He says that instead of assisting mariners they contribute to the dangers of navigation. He says the object of a light is to warn navigators of its exact location, in order that it may be avoided, and to display its characteristic features so that its individuality may be definitely known, thereby enabling a pilot, after seeing it, to set his course true. The great French lights in all bad weather utterly fail in these essentials. Their extreme visibility depends on the reflection of their great intensity from the

sky, the lantern itself being below the horizon. At times when the New York was going placidly along on a safe course, at night, overhanging clouds would catch the reflection of one of these lights and startle everyone on the ship. It was impossible to tell the direction of the source of illumination, or whether it was 50 or 10 miles away, and for all anyone knew it might have been a searchlight signal from a ship dead ahead or astern.

The reflection of the Cherbourg light has been noticed nearly 75 miles at sea, without giving a clew to its direction. His investigations and those of other members of the board have led to the practical conclusion not to put the big light at Barnegat at present, though it might be utilized at some other point, preferably on the Pacific coast.

Standards of Practice in Electric Elevator Installation.[1]

By Percival Robert Moses.

The question arising in the design and construction of elevators have received little attention in the technical press—a surprising omission in view of the number of fatal accidents occurring, the majority of which could be avoided by consideration of elementary mechanical principles. The importance of the subject in the United States is indicated by the fact that there are more than 6,000 elevators in New York city alone, and a low estimate of the car-trips made per day is more than 500,000; while the passengers certainly outnumber those carried by the street and elevated railroads combined. The growth of this branch of the industry can be compared only to that of the "trolley." From barely 3,000 horse power on the central-station service in 1894 the number has increased until there is now more than 10,000 horse power installed. The elevators operated from isolated building plants probably bring the total to nearly 20,000 horse power.

In Great Britain and on the continent the development has barely commenced, but its possibilities are hardly calculable. Experience has shown that facilities for vertical traffic are the direct result of increased means of rapid transit on the level. While business men are restricted to the slow-moving horse car or cab, business interests were scattered; the shipowner had his office at the dock, the lawyer was at the courts, and the manufacturer at his factory; as a consequence, the building of five stories fulfilled all requirements, and the lift was a luxury. The advent of comfortable rapid transit and the telephone changes these conditions; the separate trades draw close to each other by means of business offices in the city, and the ensuing contraction causes the high building to spring up and the lift to become a necessary tool in the "manufacture of transportation." The new electric underground railroads in London will lead to the building of tall buildings of 12 stories and upward, notwithstanding the present laws, as the elevated railroads have already done in New York and Chicago. That the elevators used in these and smaller buildings will be operated by electric motors there can be but little doubt, and a study of the actual conditions will not be out of place. The mechanical problems encountered and overcome are more severe than those of street railroads; the elevator car runs on a 100 per cent. grade, is able to attain a speed of 600 feet a minute without jerking, in about a second and a quarter, and may be stopped in the same manner and time. It must be capable of continuous operation, as there is no car barn into which it can be run and repaired while another is substituted to do its work. Space is limited, and a shut-down of one elevator out of six in a large office building is a serious annoyance during the busy hours. Moreover, it must be absolutely safe and easily operated. On the other hand, the advantage of a clean, clear track and continual supervision of the operating mechanism is obtained.

Elevators are divided into those for passengers and those for freight. In the former, three sub-divisions, depending on the speed, may be recognized, viz., high speed, from 300 to 700 feet a minute; medium speed, from 150 to 300 feet; and low speed, or less than 150 feet per minute. With freight elevators only two speeds—medium and low—are necessary; high-speed freight is invariably carried by one of the passenger elevators during slack hours. In general, that passenger-elevator system is the best which gives the greatest speed consistent with safety and comfort at the least cost of operation and maintenance. The most efficient freight system is the one which transfers greatest loads quickest at the least cost of operation and maintenance.

To meet the varying requirements of speed and load three types of electric elevator have been perfected, and numerous others advocated. The three are the screw with multiple sheaves, the double worm-gear drum, and the single worm-gear drum. The methods of operation of the last two are similar, the difference lying in the absence of all end thrust and increase of bearing surface with the double machine due to two worms and wheels and interlocking gears; otherwise each has an electric motor keyed to a shaft directly coupled to the worm shaft, which operates a large worm wheel directly attached to a drum on which the car and counterweight ropes wind, transmitting movement to the car. Motion is arrested by removal of power and by application of brake on the motor shaft or closing of the motor circuit through a resistance, causing work to be done by the car or by both.

The screw type was built to compete with the high-speed hydraulic, and closely resembles it in many characteristics. Like the ordinary hydraulic elevator, it is constructed for either horizontal or vertical installation; transforms power at low speed into power at high speed by nests of sheaves and a sheave on the counterweight; has absolute and fixed limits of travel; raises the car by power, and lowers it by gravity; has a fixed lead of the ropes in the hoist-way, and allows of equalization of their work at the machine. These factors are of great importance for all high-speed work. The method of operation is as follows: Power is delivered to an electric motor coupled to a forged steel screw; rotary motion of the screw transmits lateral motion to a traveling cross-head, by a so-called frictionless ball-bearing nut, to which is attached a nest of sheaves. Ropes from the car (or counterweight) travel over these sheaves and a stationary set (at the end of the machine away from the motor), multiplying the velocity of the nut eight to 10 times. Motion is arrested as in the drum machine, but the action is assisted by gravity instead of being impeded.

The car is caused to lower by the attraction of gravity, the speed being regulated by a variable resistance in the main circuit, forcing the descending elevator to do work in direct proportion to the amount of power given out by the motor, which, by reversal of conditions, has become a dynamo.

Designing an elevator installation demands the consideration of a number of points, among which are the class of travel, distance between floors, available space, labor and power, heating system (in old buildings), probable ratio of maximum to average load, continuity of service and legal restrictions.

For example, an apartment house, seven stories high, containing women and children, and in which the service is intermittent and moderate, requires a different type of elevator from that necessary for a transient hotel, which, in turn, has needs differing from those of a loft or office-building.

The distance between floors affects the permissible speed without absolutely determining it; a small available space means few cars at high speed with skilled operators; the availability of power from a central station determines, in small buildings, the question of the motive power used; the heating system affects the type of engine or pump employed; the relation of average to maximum load indicates the amount of overbalance, kind of motive power to be used, and the rating of the machinery in horse power; and continuity of service bears on these points, and on the source, as distinguished from the kind, of power as well. Legal restrictions vary in different communities, but relate generally to questions of safety, and not to the type or kind of machine to be employed.

The question of prime importance in elevator design is that of safety. Economy of operation and ease of control are large factors, but, no matter what else may have to be sacrificed, human life must be secured. Accidents may occur either from carelessness or from faulty design. The former may be guarded against, but not absolutely prevented; for the latter there is no excuse. A system, to be absolutely safe, should include apparatus for preventing a drop, should all the ropes break at once, or, if one should fail, for preventing abnormal speed due to excessive load or other cause; for holding the car stationary on the removal of power, or under any possible conditions of overload; for absolutely arresting the motion of the hoisting machine, and for removal of power when the car approaches the limits of travel; for immediate removal of power from the hoisting machine in emergency, if the cables slacken or in case of temporary cessation of supply; for receiving and stopping the car and the counterweight, should all the other devices fail to operate; for prevention of operation until hoistway doors are actually closed. The last condition is rarely fulfilled, the automatic house machine being alone in its compliance. Speed is of sufficient importance in the majority of cases to offset the results of possible carelessness on the part of the operator. In addition to the apparatus above mentioned, the cables for hoisting, the safety clutch for gripping the rails, the sheaves, bearing, and, in fact, all vital parts should be of a strength far in excess of average actual requirements. This strength costs little and is of great importance. Easy, reliable control and economical operation are in a degree opposed, if the fixed charges are included in the latter. An ideally controlled elevator would be capable of starting the car from rest with uniformly and rapidly accelerating velocity and minimum waste of power, of running the car at varying speeds, and of arresting motion easily for ordinary stops, and immediately for emergencies. It would be noiseless, simple and absolutely reliable in its action, and, in case of accident or carelessness of operator, should automatically stop the car. It would be so designed and constructed as to preclude accident, no matter what the operator might attempt to do. These conditions are hard to realize completely in one system, but they have been partly fulfilled by several. Two general methods of control are recognized. The first allows of varying the speed from the car; the second does not, except for starting and stopping. The object of the first method is obtained in two ways: by a pilot motor operating to vary resistance in the main circuit, as in the Sprague system, with an inverse variation of the motor field strength; and the variable voltage, or Leonard, control, where each elevator motor has a separate generator, and the speed of the car changes in accordance with the varying electric pressure of the generator. This pressure is determined by a resistance in series with the small field current, and is adjusted from the car. Both methods meet most of the conditions imposed, and the question of choice for all speeds of less than 350 feet per minute is one of comparative economy. The Leonard system is employed only for worm-gear machines, and could not be operated with the present make of screw and multiple sheave machine. The variable voltage system allows of an ideal start and stop, whether from the standpoint of economy or from that of comfort; on the other hand, from the point of total economy in operation, the rheostat control is advisable because of the necessarily continuous operation, and the first cost of a separate generator for each machine. The proportion of time during which a car is in actual motion varies with the class of travel, but even in ordinary office buildings it rarely exceeds five-eighths, and generally falls below one-half of the total operating period. In addition, each generator must be of capacity sufficient for the maximum starting load, and consequently runs at low efficiency. In this connection the following data from 17 elevators, taken at random from more than a hundred tests, is of interest. The speed varied from 60 to 450 feet per minute, the maximum capacities from 1,500 pounds to 3,000, the maximum live load was 1,600 pounds, the minimum 150 pounds, and the average only 593 pounds. A test on a tall office building showed the average load to be less than one-seventh of the maximum, and the figures on another, where the elevators were apparently worked to their fullest capacity, showed it to be less than one-fifth. In general the average live load varies from one-fifth to one-eighth of the maximum. As far as statistics show, the variable voltage system is less economical and simple than the ordinary rheostat control when applied to worm-gear machines; in smoothness of starting and operation it is superior. For low-speed machines, or for buildings where variable speed is not essential, a solenoid control answers all purposes, and its operation may be controlled directly by electricity from the car, or the shipper rope and wheel may be employed to close switches on the machine and operate the brake.

House elevators have an automatic control, which includes the following features: push-button or buttons on each floor to bring the car to the landing; automatic locks, to prevent opening of the door except when the car is about level with the floor; door switches, stopping the car if door is opened; and a device preventing the operation or calling of the elevator by more than one person at a time. This control works with complete safety and satisfaction with the various parts strongly and mechanically made. Small spring and trigger attachments are to be avoided, positive action, controlled electrically or mechanically, being substituted. Stopping the car is an important branch of the control, and is accomplished by removal of power, brake and short circuiting for heavy loads, and by the first and either of the other two for light loads. The difficulties are apparent; a car must be brought to rest within a few feet under widely differing conditions of speed and load, and this involves as well the stoppage of the hoisting machine, the counterweight and the sheaves. For this reason with heavy loads a device compelling the car to do work in stopping is almost a necessity for safe and easy operation. For very high-speed machines still another device is used, which allows the brake band to touch the pulley just before stopping, causing the car to perform direct mechanical work, in addition to the electrical work caused by short-circuiting.

The use of a brake depends largely on the construction of the worm gear. If this is of such a nature as to allow a loaded car to reverse its motion, a brake is a necessity for holding the elevator in position. If the gear will reverse only when actuated by the motor, the brake becomes an emergency stop, and short circuiting, combined with the friction of the worm, is relied upon for ordinary occasions. This latter method involves the use of a worm gear with a more acute angle of contact, entailing increased friction and decreased efficiency, and requires a larger current for the down start and running. It has, however, an added element of safety.

Correct counterbalancing has an important bearing on the successful operation of the car. Efficiency and ease of running are in a degree opposed. Theoretically, that system will be under the best control which has the least inertia; hence the use of a counterweight tends to reduce the certainty of control, and this result increases with the speed. Practice has shown, however, that, so long as the car exerts one-quarter to one-half more downward force than the counterweight, no trouble need be

1. From the Engineering Magazine for December, 1897.

feared. With the drum machine and a speed of 350 feet a minute or less, two counterweights may be employed, the car counterweight exerting two-thirds as much force as the car unloaded, and the drum counterweight, the ropes of which wind on the drum in an opposite direction to the car ropes, exerting a force equal to that due to the unbalanced weight of the car and to the average load. Where lights or motors are to be supplied from the generators that supply the elevators, the question of economical operation gives precedence to steadiness of pressure, and it may prove advisable to have the counterweight balance one-half the maximum load. In high buildings a varying counterweight must also be employed to allow for the change in the force exerted by the ropes, as the car moves up and down the shaft, and for the decrease in load in the upper portion of the building. This variable counterweight is a heavy chain, attached at one end to the bottom of the car, and at the other to the counterweight, or to an anchorage in the hoistway. With high-speed service the car should descend by its own weight, and should never be overbalanced. A system involving the opposite principle—i. e., a counterweight exerting a force greater than the car fully loaded—is in use and should be condemned. The inertia of the system is nearly doubled, and in case of accident and failure of safeties, the ropes are sure to break with the car at the top, dropping it the whole height of the building. With reduction of inertia in view, the counterweight for high-speed cars moves at only one-half or one-third the velocity of the car, the weight being increased in proportion. This reduces the total inertia of the system, and, in addition, decreases the cost of the counterweight, guides and ropes.

The proper speed for a given building is one which will enable a trip up or down to be made in half a minute without stops. This figure will be modified to a certain extent by local conditions, but is a rough approximation. Apparently the speed should depend on the number of passengers to be carried, but this varying condition must be met by the size of the car, as there are certain periods of the day when the tenants all move, and high speed is of no advantage. Express elevators to the upper half or third of a tall building have been used with doubtful success. Crowding out of lower-floor tenants is almost prevented, but a number of annoying features have arisen, such as restriction of ease of intercommunication, mistakes in cars, etc. In addition, during all but the "rush" hours two cars are fulfilling the duty of one. Velocity of service is increased by floor calls and indicators showing the position of the cars. Variable speed is a necessity where the cars are required to run at certain distances apart, or where elevators are run from a lighting plant.

For high buildings, with elevators running from 350 to 700 feet per minute, the increase in the inertia of the system and in the probable and possible strains due to sudden stoppage must be met by increased cable strength, fixed and absolute limits of travel, an underbalanced car with a counterweight moving at one-half or one-third its speed, etc. These conditions are filled only by the hydraulic and screw electric machines. The worm-gear drum machine is unfitted for such work, as it has an endless character of movement, and can not have double or triple ropes on the drum, on account of the size of drum necessary and the impossibility of equalizing their work at the machine. With the screw and ball nut type multiplication of the speed is effected by multiple sheaves on the nut; the ropes from the last of these sheaves are attached to the bottom of the counterweight. From an anchorage at the top of the shaft other ropes pass around a sheave fastened to the top of the counterweight, and thence over and around the overhead sheaves to the car. Short distances between floors and the necessity for a quick stop indicate probable limits of multiplication. An interval of one second with the screw turning 250 times per minute would carry the car 8 1-3 feet in a second, with a multiplication of 20 to 1. The practical limit lies at about these figures, and higher car speed must be obtained by increasing that of the machine. For buildings with elevators running from 150 to 350 feet per minute the double worm-gear drum elevator satisfies all requirements. In this the speed is varied by the ratio of the worm wheel to the worm, and by the size of the drum. Up to a certain limit, with a worm of given size, the greater the ratio, the more economical is the operation of the gear and of the electric motor due to the increased angle of contact, decreased friction at high speed, and electrical losses. By increasing the diameter of a worm, the path traveled by the point of contact with the wheel is increased, and the angle of contact decreased for a given pitch, rendering a reversal of rotation of the worm by the car more difficult. However, more surface is obtained if the gears are correctly cut and variation in speed and work is more gradual. Consequently heavy loads require large worms. The limit of multiplication is fixed by the size of the drum, which, in turn, is determined largely by the height of the hoistway, and in some cases by the space allotted to the elevator machinery. For residences, apartment houses and sidewalk hoists, requiring speeds of 150 feet per minute or less, the single worm-gear drum is used exclusively, and is operated by a solenoid or by automatic control. As these machines receive little or no care, they must be simple and automatic in their action, and at the same time be capable of receiving bad treatment without injury; hence self-oiling bearings, self-cleaning switches, enclosed motors and parts, and magnetic blow-outs or other arc arresters are desirable. Where the car is run but seldom, it may be advisable to counterweight for one-half the maximum load, in order to decrease first cost of the motor; but the question is not of importance. The requirements of the motors for all the three types are strength, sparkless commutation with all loads and speeds, ventilated armatures, careful securing of lugs, commutator bars, and winding, and avoidance of sharp corners, fields variable and balanced, etc. Devices for opening and closing the circuit without destructive arcing involve either the magnetic blow-out or the divided arc principle for all heavy work. For light loads a quick, long break answers all purposes. In general, high speed is not advisable or essential. The hoistway should be of a fireproof material and covered by a skylight, with a screen placed immediately below the overhead machinery. Ample room above and below the car at its limits of travel, to provide for possible slip or stretch in the ropes, should be allowed. If grille work is used, a simple, open pattern, giving a clear view of the landings, is most satisfactory to the operator, and may be made entirely safe.

Operation of elevators from the lighting engine is frequently desirable; with overbalanced machines carrying moderate loads this can be accomplished by adopting a slow starting device or by running the generator below its rated output. In either case, even with perfect engine regulation, a flicker in the lights will occur, due to the electrical reaction of the varying current. With underbalanced machines the flicker is more noticeable and can be removed only by the employment of a separate generator for power—coupled or belted to the lighting engine, or by the use of storage batteries in connection with a booster motor-dynamo.

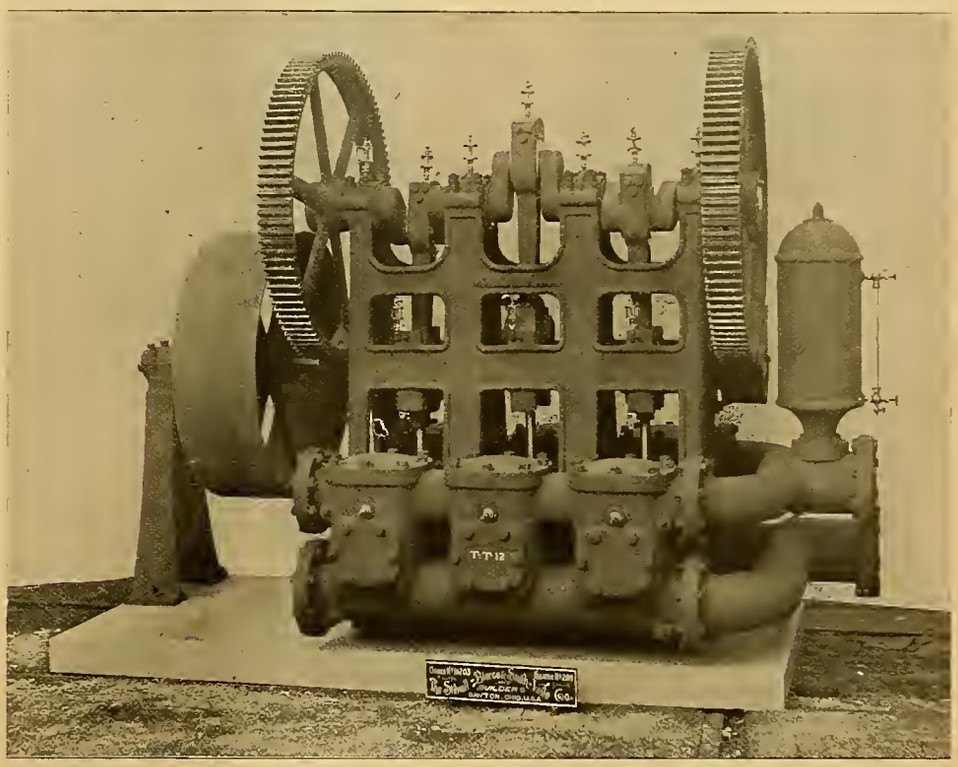
Where a number of worm-gear elevators are installed, a large economy results from the balancing action of the descending elevators, which return current to the source, aiding those ascending.

The cost of electric elevator operation is lower than that of any other practical method. The power required per car-mile in office buildings varies from two kilowatt-hours (with the overbalanced worm gear) to four kilowatt-hours (with the underbalanced screw). Approximate costs on the central service at 10 cents per horse power hour for small, and 10 cents per kilowatt-hour for large, consumers are $3 to $10 for residences, $10 to $20 for apartment houses, $15 to $40 for loft and small office buildings, and $40 to $90 for tall office buildings, per month.

In conclusion, an answer to the question so often advanced: "Are electric elevators safe and reliable?" will not be unfitting. Electric elevators are the safest vehicles to travel in known to humanity; none have ever fallen, nor have people been killed by them except through their own carelessness—a remarkable record considering the novelty and number of machines installed. Like the motor of the trolley car, they run in positions apparently ruinous to fine machinery, such as buildings half completed and damp holes, without serious damage; they require but little attention, oiling and cleaning being necessary only once or twice a day, and are highly efficient.

Double Acting Pumps.

It is contended for the triplex pump of the Stillwell-Bierce and Smith-Vaile company of Dayton, Ohio, which is herewith illustrated, that it possesses special merit on account of dividing the work on the shaft so that a card taken off the water end shows very near a true line. Among the features of this pump not shown in any other design are four standards, giving four bearings on the crank; in other words, placing the piston connections with a bearing on each side. The pistons coming out of the cylinder are guided, running in cross-heads, with brass shoes which are adjustable. In this way a perfect alignment is preserved at all times and the stuffing boxes will not cut out. Still another feature that is found only on the double acting pumps of this company is that the cylinders are made and cast separate from the pump, and are in this way removable, so that they can be supplied any time. The frame is raised high enough above the pump so that they are perfectly accessible to pack. The valves are given a very large area, over 50 per cent., which allows a high speed without any undue friction or hammering. All the valve seats are made of composition and are screwed in. Where thick liquid is used or stuff pumps, the valve chambers are altered somewhat and ball valves are used. Cut gear is employed ,and for pressures of 150 pounds and above, bevel gears, while for 80 pounds and below there is a single gear.



DOUBLE ACTING PUMPS.

Where a motor is used an extra base is cast, and it is flanged and bolted up to the pump base. The double acting pump gives a very even load on the motor.

Successful Trial of the Gorner Grat Railway.

The first trial trips on the electric railway up the Gorner Grat, near Zermatt, were carried out last week in the presence of the inspectors of the Swiss Railway Department. The section already completed has a length of 1,600 meters and a gradient of 12 per cent.

The tests were satisfactory, both the ascent and descent being effected without the slightest difficulty, the motors holding the locomotive perfectly to its proper speed. Starting on the maximum gradient with a fully loaded train was also effected with great facility.

It will be remembered that this is a rack railway, the total length being 9.8 kilometers and the maximum gradient 20 per cent. The power is derived from the Findelenbach, which drives four turbines of 250 horse power each, coupled directly to three-phase alternators of 5,000 volts. Transformers are placed in the power house itself for feeding the line as it passes the building, and two other transformer stations are provided. The tension of the trolley line is 550 volts. Each locomotive is equipped with two three-phase motors of 90 horse power each, driving the main pinions by spur-gear. Owing to the property of three-phase motors, by which they

will act as generators and take up the full power which they are designed to give out as motors, when driven at two or three per cent. above the speed of synchronism, the locomotive will, in descending, give power back to the line. In case only descending trains should be on the line, the surplus power will be taken up in a water resistance in the power house.

The contractors for the electrical equipment were Brown, Boveri & Co., who, in the well-known Lugano tramway, were the first to apply the three-phase system directly to traction. They have also supplied the electrical parts of the locomotive for the Jungfrau railway, where their system is to be adopted, and are now engaged on the equipment of the line from Stansstaad to Engelberg, which is to be running next spring.

The standard gauge line from Burgdorf to Thun in Canton Bern is also to be equipped by them on the three-phase system, the power being taken from the power station on the Kander.

Show Window Illumination.

In economy and brilliancy the Wheeler Reflector company of Boston maintains that it can obtain results in lighting show windows with its new reflectors that cannot be reached in any other way.

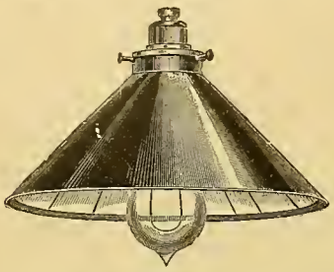


FIG 1. SHOW WINDOW ILLUMINATION.

The cuts illustrate the methods employed. It is proposed to place the reflectors (Fig. 1) on ball and socket brackets, at the very front of window, close to the ceiling, the curtain hiding lamps from view on sidewalk. Fig. 2 shows how the light is utilized. The reflector is lined with sixteen pieces or facets of silver-plated mirror-glass. Each facet reflects downward substantially the same amount of light as is given by the lamp itself. The cut shows an under view, with 16 candle power lamp.

Storage Batteries in Street Railway Work.

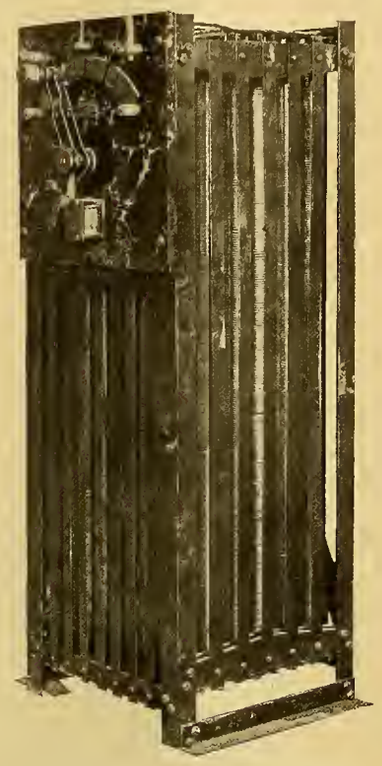
At the last annual meeting of the American Street Railway association, held in Niagara Falls in October last, Charles Hewitt of Philadelphia read a paper on the application of the storage battery to electric traction which attracted attention to this

FIG. 2. SHOW WINDOW ILLUMINATION.

subject, and provoked a general discussion. It was clear that the usefulness of the storage battery in the field mentioned was recognized, and one of the results is now apparent, the Buffalo Railway company having decided to establish a large storage battery plant in connection with its already extensive outfit. This addition will one of the largest and most progressive improvements ever made by a street railway company, and the operation of the battery on so large a scale will be watched with great interest by street railway operators and electrical engineers throughout the country.

The capacity of the battery to be installed will be 1,200 horse power hours. The battery will contain 290 cells, each of which will weigh 1,200 pounds. It will occupy 2,800 feet of floor space, and be constructed in large iron tanks. In order to accommodate it, a new fireproof building will be erected adjoining the railway company's plant on Niagara street, and in this building the battery will be placed. It is expected to be completed in 90 days, so that probably it will be in operation early in March next. The company is quite enthusiastic as to the benefits it will derive from the battery, so much so that it will provide tanks, in which the cells will be placed, considerably larger than are necessary to meet the present needs. The object of this is so that the battery may be increased by the addition of plates without enlarging the tanks. In this way, with the size tanks that will be put in, it will be possible to increase the capacity of the battery 66 2-3 per cent.

The battery will be a substantial reserve operating force. Should anything happen to one of the company's engines, to the boiler plant, or to the supply of power transmitted from Niagara Falls, the storage battery would take the load and help out until the original plant would be in good shape again. The Niagara Falls Power company furnishes a 24-hours' service, but all the street cars do not run that length of time, making it possible to store some of the power furnished for use at other times of the day. The lines are busiest about six o'clock in the evening, and then it issometimes necessary



MOTOR SPEED REGULATING RHEOSTAT.

to supply more power. When the battery has been installed, instead of turning in another engine to get more power, the company will simply draw from the storage battery and use the reserve power it will contain.

The Electric Storage Battery company of Philadelphia will supply the plant, which will be the first to be put into use on a large system of street railways in this country. In Philadelphia the Union Traction company is using a battery for the suburban service, and it was the experience in the operation of this plant that Mr. Hewitt related to the American Street Railway association at Niagara Falls last October.

Silver Medal Awarded at Nashville Exposition.

The G. & H. Barnett company of Philadelphia received a silver medal at the Nashville Exposition for the excellence of its goods. This was the only

SILVER MEDAL AWARDED AT NASHVILLE EXPOSITION.

award made in the line which this company exhibited. The accompanying cut illustrates the medal, which the company is naturally very proud of.

Three-cent Fares Don't Pay.

[From the Detroit Evening News.]

A report comes to the News from a high source, in fact from several sources, that the Detroit railway (three-cent fare railway line) was unable to meet the interest on the bonds when the latest payment became due.

There also comes a reiteration of the report that Tom L. Johnson declines to keep a promise alleged to have been made at the time of the so-called consolidation of the Citizens' and the Detroit companies that if the Detroit didn't earn enough above operating expenses to pay its bonded interest he would see that it was paid.

Motor Speed Regulating Rheostat.

The speed regulator of the American Rheostat company of Milwaukee is constructed with sufficient capacity to carry the full current continuously without excessive heating. Every part is fire-proof, and it is built with or without the automatic release. With the automatic release it has all of the advantages and protection of an automatic starting box in addition to the convenience of speed regulator. The arm can be carried over the contacts in either direction, as desired, and the automatic release is operative at any point. This operation is simple, requiring no complicated parts.

The necessity of an automatic release on a speed regulator is exactly the same as on a starting box, as the current from the power plant is liable to be suddenly cut off at any time and just as suddenly thrown on.

The standard size is built for a reduction of 50 per cent. in the speed under full load. It should be borne in mind that a speed regulator in the armature circuit does not give the same reduction of speed for any load on the motor. If constructed to reduce the speed 50 per cent. under full load it would give but very little reduction with no load on the motor.

New West End Lease.

A special meeting of the stockholders of the West End Street Railway company was held at Boston on December 9th, and the terms of the new lease of the West End to the Boston Elevated Railroad company was authorized to be executed. In the place of a 99-year lease on a dividend basis of eight per cent., which was rejected several weeks ago by the railroad commissioners, this new lease, while conforming in its general scope to the original one, substitutes a 25-year tenure and a seven per cent. dividend. The new lease now goes to the railroad commissioners for approval. The commissioners, although they know the terms of the new lease, have declined to state whether the modification is all that they will require, but the general opinion in financial circles is that they will offer no objection to it.

Penny-in-the-slot Electricity.

[From the London Mail.]

A novel departure in connection with the new artisans' dwellings, which the Shoreditch vestry are erecting, will be the provision of penny-in-the-slot electric light meters, so that the tenants may be able to avail themselves of the most modern illuminant. Lord Kelvin, when he visited Shoreditch, said that the vestry ought to be able to supply electric light more cheaply than gas is supplied, and, as a matter of fact, the penny-in-the-slot consumer will find that for 2s. 10d. he will be provided with electricity equivalent to 1,000 feet of gas. When the extra charge made by the gas companies for the provision of the fittings is taken into consideration the vestry's price compares favorably with that of the companies, though of course the electric light will not be available for heating purposes.

Further inquiries elicited the information that the favorable position in which the vestry finds itself for providing electric light at a cheap rate is due to the fact that, instead of having to pay for fuel for its electric stations, it is actually paid to receive it. Manufacturers are glad to give the municipal authorities payment ranging from a shilling per ton upward to take their refuse, and indeed the stations use a few tons of coal on Sundays only when no refuse is available.

The development of the dust destruction undertaking is marvelous. Even after the refuse has passed through the furnaces it is still valuable, since it is made up into flagstones and also used for the purpose of fireproof flooring. And even the waste steam from the central station is to be utilized for providing the necessary heat for the adjoining public baths and washhouses now in course of erection.

In addition to light, the vestry supply electric power to workshops, and this should be a great boon to the many small firms engaged in the furniture industry in Shoreditch. It is claimed that electric power is cheaper and more efficient than steam power, since there is no waste, as the motor can be got right on to the lathe, or other instrument used, while a boy can work it by pressing a button.

Shepherd Killed by Lightning; Flock Wanders 500 Miles.

An interesting story comes from Albuquerque disclosing the fate of a shepherd in Arizona whose flock was found wandering in New Mexico, 500 miles from the tragedy described. A herder in charge of a flock of 2,000 sheep which were grazing near the base of the San Francisco Mountains in Arizona was killed by lightning during a terrific storm which visited that section about August 1st. As the herder was not expected to come in with his sheep until October 1st, his absence during August and September was in the regular line of business and attracted no attention, but when the middle of October came and he did not appear messengers were sent out to find him and see what was the matter. After a search of some days in the vicinity of where he was last seen, the remains of a camp were found under a tree which had been riven by the lightning. The cooking utensils were scattered about and the remains of a blanket were found, which were identified as parts of one which the man had taken with him. The water keg was also recognized by a mark which had been burned into one of the staves. A further search revealed the bones of a man scattered about over the ground, some of them more than 100 yards from the tree, where they had evidently been carried by the wolves.

A prospector who had passed that way had camped a night with the man about August 1st, and said the herd was then moving northward. This tree, around which these articles were found, was just about far enough north to have been the next camping place, and as it was remembered that there was a severe storm with thunder and lightning in that section one night about the time referred to, it was assumed that the man had made his camp under this tree, and had been killed by lightning and his body devoured by wolves. The sheep had never been heard of, and no trace of them could be found anywhere in that part of the country.

About three weeks ago a herd of about 2,000 sheep was found on the plain in San Miguel County in New Mexico, with no one in charge of them, and to all appearances, belonging to nobody. The people in Arizona heard of this fact and wrote to an officer in the county where the sheep were found, giving their marks, and explaining how the animals could be identified, when it was found beyond any doubt that this was the same herd that had disappeared from the range in Arizona about August 1st. They had been shifting for themselves for at least three months and a half, and turned up at a point fully 500 miles from where the herder was killed, and had crossed the Rio Grande on the way.

President Ingalls on the Future of Railroading.

M. E. Ingalls, president of the "Big Four" railroad system, in the course of a recent address on "Railways of America" at Purdue University, said: "Probably locomotives propelled by electricity will come in the future. If not, something else may. And we cannot tell what the next years have in store in the way of improving our railway facilities; higher speed, possibly cheaper trains, but it is necessary to this country of ours that the railways should be encouraged so that they may go on improving their systems, so that branch lines can be built to every county seat in the country. Instead of stopping at 182,000 miles of railway we should build at least 5,000 miles a year in short and inexpensive lines, as feeders to the main systems, so that the days of the stage coach and the heavy wagon should be unknown. This country will soon have 100,000,000 of people. It will require at least 250,000 miles of railways to serve them properly—an increase of 40 per cent. over the present mileage. They cannot be built, they cannot be improved and increased with the present system of legislation and with the present prejudice against them. The development of the country demands that this must be changed. It is through such institutions as this, it is through such students as these, that the change must come. In the centuries that have gone the youth of the various countries sought fame and preferment in war and its accompaniments. We live in better days and in a higher civilization, but the service of our railways offers a wider field for advancement and fame than anything of old. The road to success in this line is not through carnage and suffering, but it is none the less sure and requires equally moral courage and intelligence. A new evangel must be preached in reference to railways; they must be placed upon a higher order, and instead of being pariahs in business, they must be the benefactors and friends of all."

Electricity in Cotton Mills.

At the annual meeting of the American Society of Mechanical Engineers, a paper was read by W. B. T. Whaley of Columbia, S. C., on "Electricity in Cotton Mills," in which he told of some comparative tests which were made of two mills of nearly equal size, in one of which the spindles and looms were run by steam and the other equipped with electric motors. One notable advantage which the latter mill had because of its electric equipment was that it required only about 122,000 pounds of shafting to make its connections, as against about 136,000 pounds for the steam mill. The steam mill required more oil and other items of running cost, while in six months the other mill did not require a cent for repairs to the motors. The electric mill could be operated in parts also without running all the shafting. The test showed that there was a saving in friction in the electric mill of 77 horse power.

Independent Telephone Exchanges.

[From the Chicago Chronicle.]

The independent telephone interests take exception to an article recently given prominence in an eastern financial paper, containing a list of cities and towns in the United States where independent telephone companies had given up the field in favor of the American Bell Telephone company. The independent interests claim that the tendency of the article was to impress readers with the idea that the independent telephone movement was not succeeding and declare that the list published included less than four per cent. of the independent telephone exchanges in the country. The list referred to was composed of 45 exchanges, and the independents claim that quite a number of them were bought out by the Bell telephone interests at a price well above their original cost. It is claimed there are over 1,200 independent telephone exchanges in operation in the United States to-day and that they represent an actual investment of between $20,000,000 and $30,000,000. Ohio heads the list with 173 exchanges; Illinois comes second with 169; New York has 164, Pennsylvania 147, Indiana 142, Iowa 139 and Michigan 133.

Engineering Association of the South.

At the annual meeting of the Engineering Association of the South the acting secretary announced that at a meeting held November 12th, ballots for officers for the ensuing year were canvassed and resulted in the election of J. S. Walker, Nashville, Tenn., president; Prof. W. H. Schuerman, Nashville, Tenn., vice-president; William B. Atkinson, Earlington, Ky., second vice-president; C. B. Wilson, Nashville, Tenn., secretary and treasurer; Hunter McDonald, Capt. John Biddle and L. P. Brown, Nashville, Tenn., directors.

CORRESPONDENCE.

New York Notes.

New York, December 14.—There has been a lively scramble for franchises and privileges of all kinds in every part of Greater New York during the last year, but nothing more comprehensive has been suggested than the application that has been made recently to nearly every board of town or village trustees, supervisors or highway commissioners in Richmond County—soon to become a borough of Greater New York—for a franchise described in the following resolution:

"Resolved, That M. Menzenado, Edward Wisely, John S. Warde, Erastus F. Mead, G. N. Whitney, H. P. Whitney, Fred L. M. Masury, John Irving and G. Lynch, their executors and administrators and assigns, are hereby collectively authorized and empowered to construct subways, to erect, lay, construct, operate, maintain and use (and collect tolls, rent and compensation therefor), in, on, under, over, through and along all streets, lanes, alleys, squares, public parks, highways and places in the village of New Brighton, wires, pipes, tubes, poles, conductors, conduits, fixtures, appliances and appurtenances for the purpose of conducting and distributing electricity, gas, water, oil, fluids, wires, steam, compressed air and any other property, substance or product capable of transportation of transmission therein or thereon by any force, power or mechanical agency, and to erect and maintain all necessary and convenient buildings, stations, tanks, fixtures, machines and appliances for the proper conduct and distribution of the aforesaid property, substances or products.

"And the said grantees, and their executors, administrators or assigns, collectively, as aforesaid, are authorized and empowered for the purpose of constructing and maintaining all of the same, to open the streets, highways, sidewalks and public places of the village at all times. Immediately after any work they agree that all streets, highways, sidewalks and public places, shall be restored to the same condition as before such opening.

"The said grantees shall take steps to induce all persons and corporations having wires and poles in the streets to put the same underground, and for the rights and privileges herein granted, the said grantees or their assigns shall the first year pay to the village of New Brighton the sum of $100 and in addition one-half of one per cent. of their gross receipts, and after the first year they shall pay to said village each year one per cent. of their gross receipts. That before any streets or public places shall be opened a bond in the penalty of $5,000 shall be filed with the clerk of the village to secure the restoring of the streets and public places and to indemnify the village against accident. All work shall be finished to the satisfaction of the Board of Trustees."

The order of Justice Smyth enjoining the Board of Aldermen from granting a franchise for the Kingsbridge railroad, on the application of the Forty-second Street, Manhattanville and St. Nicholas Avenue Railroad company, for more than 25 years, has been affirmed by the Appellate Division of the Supreme Court. Justice Rumsey holds that section 73 of the new charter, which says that "after the approval of this act," the "Municipal Assembly" shall not grant franchises for more than 25 years, must be construed by "eliminating the words Municipal Assembly" to mean that from the date of the enactment of the charter franchises to use the streets of the city for a longer period than 25 years shall not be granted. The charter became law on May 4, 1897, and the prohibition applies to all franchises to use the streets granted in the Greater New York territory since that date. The court says: "For many years it has been sought to devise some means by which the city of New York might obtain some compensation for the grant of franchises to use its streets for railway and other purposes. Such grants were of great value to the corporations to which they have been given, yet but little if any revenue had been derived therefrom by the city. It was quite apparent that upon the organization of the greater city such franchises would be still more valuable than they had been before, and it might have been expected that as soon as the act constituting the greater city should become a certainty pressure would be put upon all these various municipalities which for a short time possessed the right of granting permanent franchises to grant such franchises to corporations before the statute creating the Greater New York took effect. That this was the condition of affairs, and that this was a reasonable and probable expectation, is well known to everybody, and it must be considered in giving construction to the provisions of the section now under consideration."

The question of continuing the injunctions restraining the Brooklyn Board of Aldermen from passing over Mayor Wurster's expected veto a franchise to the East River and Atlantic Ocean Railroad company for the use of about 25 miles of streets was argued before Justice Van Wyck in the Supreme Court in Brooklyn, December 8th. Justice Van Wyck granted temporary injunctions restraining Mayor Wurster from approving the aldermanic grants, and also restraining the aldermen from passing the franchise over the mayor's expected veto. Injunctions were also granted holding up the franchises applied for by the Flatbush Gas Light company and the Municipal Electric Light company. Corporation Counsel Burr, who appeared for Mayor Wurster, said that Mayor Wurster feels it to be his duty to veto the resolutions. He makes no charges or insinuation of fraud, corruption or improper motives against the aldermen," said Mr. Burr. He believes they have done an illegal act, although possibly they were innocent in doing so." Former Senator David B. Hill, in opposing the grants, said that under the new charter the action of the aldermen was void in granting a franchise in perpetuity, as the new charter was in reality in operation after the date of its approval. He said that if the franchise was allowed to stand, it meant that 25 miles of streets which the greater city of New York was entitled to would belong to a private corporation. The charter, he said, was very plain in its language; and meant that after the charter was approved no franchise could be granted in perpetuity. It also meant that the powers of the present aldermen were simply suspended in this respect until the organization of the Municipal Assembly. He also argued that under the new charter no franchises could be granted unless the Board of Estimate and Apportionment had given its permission.

Concerning the stories that several syndicates had been formed to construct the underground tunnel, William Barclay Parsons, chief engineer of the commission, said: "I know that there are at least three syndicates which are entirely responsible and financially able to undertake the contract, which have employed lawyers and engineers, both of high standing, to assure the commission of their actual intent to enter into competition for the contract and to look into the plans and estimates. I know a few of the persons who are interested in these inquiries, but I do not believe that either Mr. Orr or the other commissioners are aware of the identity of the principal men back of the schemes. Naturally, it is the purpose of these men to keep their identity unknown, both for their own reasons and to save embarrassing the commission. Engineers of high standing have been at work for months in my office looking over the plans and making computations of cost." Mr. Parsons said it was quite possible that before the contract was offered the three syndicates he mentioned might make a combination and offer only one bid.

General Collis has asked the Gas Commission to allow him to double the number of electric lights in Fifth avenue from Eighth to Fifty-ninth street, where he said the finest hotels, clubs and restaurants in the world were located, and which is also a great passageway for pedestrians. The estimated cost for the increase of light there is $16,000.

A handsome residence owned by P. B. Delaney, the electrical inventor, in Scotland road, South Orange, was destroyed by fire on December 5th. The house was occupied by Mr. and Mrs. C. L. Van Rensselaer, and jewelry and valuables owned by them, to the value of $10,000, were lost in the fire, which started from a drapery that was blown against a gas jet.

Among the recently incorporated electrical companies reported by the secretary of state is the Bowery Bay Electric Light and Power company, to furnish electricity for lighting and other purposes in Long Island City and Newtown, the capital stock of which is $10,000. George Ehret, John B.

Hasslocker and Edward M. Burkhard of New York city, Louis von Bernuth and Walter C. Foster of Long Island City, are named as directors.

In a recent case in the Yorkville Police Court, Magistrate Deuel censured the Board of Electrical Control for allowing a wire to be kept strung across Madison avenue for five years and then ordering the arrest of men who tried to repair it. The case on trial was that of Patrick Sullivan, a driver, and John B. Parker, an electrician, who had been arrested at the instance of Andrew M. Cameron, an inspector of the Board of Electrical Control. Cameron was sent by Superintendent Brown of the Board of Electrical Control to Madison avenue to cut a wire stretched across the avenue at Fifty-eighth street. The wire ran between the Madison Avenue Hotel, the Savoy Hotel, the Lenox Lyceum and ex-Alderman Hall's stable, at Sixty-second street and Madison avenue, and was used to communicate with Mr. Hall's stable. The wire has been up for five years, and Superintendent Brown told Cameron to cut it down, and wait there for a time. If anyone came to repair it he was to be arrested. Cameron cut the wire, and soon Parker and Sullivan came to repair it. Cameron got a policeman to arrest the men, and they were arraigned in the Yorkville court on the charge of violating the law which prohibits the stringing of overhead wires. When the case had been explained to Magistrate Deuel, he said: "These two men simply repaired a cut wire, which had been permitted to remain in existence with the knowledge of the Board of Electrical Control for five years. I regard the board as negligent in not having enforced the law all this time. These men simply repaired the wire. They are innocent of any wrongdoing, and are discharged." The Board of Electrical Control is determined that the wire shall come down, and ex-Alderman Hall is as determined that it shall stay up, so that there is the possibility of a legal contest.

The New York and Philadelphia Traction company has won a victory in its war with the Brunswick Traction company in Somerset County, N. J. Two months ago the Brunswick Traction company started to build a line from New Brunswick to Bound Brook on the north side of the Raritan River. About the same time the New York and Philadelphia Traction company hurried to get the right-of-way to build a competing line from Bound Brook to New Brunswick on the south side of the Raritan River. The Franklin Township committee and the commissioners of South Bound Brook were held up by an order issued by Chancellor McGill, at the instigation of the Brunswick Traction company, which restrained the New York and Philadelphia Traction company from building or operating in the state. When the case was recently argued Chancellor McGill said he had issued the writ with the understanding that the people of Somerset County objected to the construction of a trolley road by the New York and Philadelphia Traction company, but as the affidavits presented by the defendants showed that the chief objection came from a rival company he would strike out that part of the restraining order prohibiting the New York and Philadelphia Traction company from building or operating in the state. The commissioners of South Bound Brook and the Franklin Township committee held special meetings at once and granted the delayed franchise, giving the New York and Philadelphia Traction company the right-of-way from Bound Brook to the Middlesex County line, a distance of seven miles. The company has agreed to construct its line within 90 days. The Brunswick Traction company has constructed its line on the north side of the Raritan River, but is held up about one mile from Bound Brook through trouble in crossing the tracks of the New Jersey Central railroad. The New Jersey Central is openly supporting the New York and Philadelphia Traction company, and a constant watch is kept on the crossing in order to frustrate any attempt of the Brunswick Traction company to put a large force at work in the night.

The Appellate Division of the Supreme Court in Brooklyn has confirmed the judgment obtained by the Brooklyn Elevated Railroad company compelling the Nassau Electric company to charge 10 cents fare over its West End trolley route to Coney Island. The damages, however, of $15,000 given by the lower court, were reduced to $10,000.

The Court of Appeals has affirmed the order of the lower court in the case of the people on the relation of the Brooklyn City Railroad company and the Brooklyn Heights railroad against the Brooklyn Board of Assessors, the appellants. This was an appeal from the order of the Appellate Division affirming the decision and order of the Special Term setting aside the assessment in 1896, for purposes of taxation of the capital stock of the Brooklyn City Railroad company in the sum of $4,032,350 made by the assessors, and directing a reconsideration and reassessment, if any may be had, of such capital stock. The Brooklyn City road is leased by the Brooklyn Heights, and the latter pays the taxes levied on the former.

Negotiations have been begun in Brooklyn looking to a combination between all the trolley lines, on a traffic agreement, so that they may be operated as one system. The two elevated railroads, it is said, may also be included in the deal. It is estimated that nearly $1,000,000 a year would be saved in the running expenses if the scheme could be accomplished. President Rossiter of the Heights company admitted that the subject had been under consideration now for over a year. "There is no doubt that it would be a great thing," he added, "both for the railroads and the public. I am heartily in favor of it, and I do not care whether it comes in the form of a combination, actual consolidation, traffic arrangement, lease, or just an agreement. But as yet nothing definite has come of it."

Those who are interested in the application of electricity to canal propulsion will be surprised to learn that, like all political jobs, the original appropriation for the improvement of the canals in this state was only sufficient to get the work well started. The $9,000,000 appropriation to improve the state canals will fall far short of the amount required for the work. The $9,000,000 is almost wholly expended, and last week State Engineer Adams informed Superintendent Aldridge that another appropriation of $5,000,000 would be needed to complete the improvements already begun to the Erie, Oswego and Champlain canals. So far the improvements have cost $1,000,000 more than had been anticipated, owing to the difficulty met with as the work progressed. About 153 miles of the canals remains to be improved, a large portion of which must be done on the Champlain and Oswego canals. The Legislature will have to decide whether $5,000,000 additional shall be spent on canal improvements. Superintendent Aldridge says the improvement is about half completed, and that if the work is abandoned now great damage would result. M. S.

New England News.

Boston, December 13.—Another link has been forged in the chain of franchises necessary in order to electrically unite Fall River, Mass., and Newport, R. I., the little town of Tiverton, R. I., having recently granted the location within her precincts asked for. Favorable action is expected by the other town authorities when the proposition for constructing the road is brought to their attention. Anthony, Tucker & Co. of Boston, who are the promoters and financiers of the new line, were instrumental in securing Tiverton's endorsement. The company is to commence work before July 1, 1898, and complete it within one year from that date.

An important petition has been received from the Boston Electric Light company by the gas and electric light commissioners. The company wants authority to issue $800,000 additional capital stock to purchase real estate upon which to build a new generating station in connection with its existing plants. The company already has outstanding $1,700,000 stock. A few years ago the Legislature authorized the company to increase to $3,000,000. It is under the provisions of that law that the company now seeks its increase. C. S. G.

PERSONAL

M. K. Bowen and William B. Walker have been elected managers of the Chicago City Railway company in place of James C. King and Erskine M. Phelps, resigned.

H. L. Parker, the president and manager of the Emerson Electric Manufacturing company of St. Louis, was a recent Chicago visitor. In company with W. W. Low, the president of the Electric Appliance company, Mr. Parker made a number of pleasant calls in this city.

Wooster Blake Curtis of the General Electric company and Miss Julia Marshall Caldwell, daughter of Marshall O. Caldwell of Schenectady, were married on December 7th. Mr. Curtis is a native of San Jose, Cal., and an honor graduate of Tufts College. He has been with the General Electric company during the last five years, in which time he has filled several positions of trust. Mr. Curtis is highly esteemed by his comrades, from all of whom he carries the very best wishes for his future prosperity and happiness.

G. Herbert Condict, who made many pleasant associations in Chicago while building the Englewood storage battery railway, of which he became the receiver, is now the chief engineer of the Electric Vehicle company of New York, and is preparing plans for a station having capacity to shelter and charge 100 electric cabs. These vehicles—50 hansoms and 50 broughams—have been ordered, and will be placed on the streets of New York at an early date. Mr. Condict is an engineer of wide experience in storage-battery applications, and his services cannot fail to be of great value to the New York company which is so extensively engaging in the operation of electric carriages.

ELECTRIC LIGHTING.

Beecher Smith of Somerset, Ky., writes that as he has secured the contract for lighting the city of Somerset, he is in the market for engines, dynamos and other electric lighting apparatus. The franchise is of 20 years' duration.

Attorney-general McCormick of Pennsylvania granted the petition of the Municipal League of Philadelphia for a writ of quo warranto to try the title of the seat of Henry Clay, a member of the Select Council in that city. It is alleged that Mr. Clay is interested in electric light companies which have contracts with the city, and that, therefore, under the act of Assembly he is ineligible to a seat in council.

A boiler in the Citizens' Electric Light and Power company's power house in Portsmouth, Va., exploded on the afternoon of December 7th, fatally scalding one man and killing the fireman, Ben Dennis. The engineer escaped with a few bruises. The boiler room was completely wrecked, the end of the engine room torn out, and the boiler blown 100 yards across a pile of cordwood 20 feet high. Bricks were blown through the windows and roofs of nearby houses, and debris was found blocks away. The cause for the explosion is not known, but it is believed to have been low water. The plant supplied the stores and business houses with light, and many of them were in darkness as the result of the explosion.

The Town Board of Trustees of Jamaica, L. I., on December 10th created a lighting district, taking in 50 square miles of territory, which is mostly farm land. Within the area there are 80 miles of improved highways, and the Town Board decided to have these highways lighted by electricity. Should the town officials give out a contract for arc lights 300 feet apart it would cost about $125,000 a year to maintain the system of lighting, most of which would be paid by New York taxpayers. A curious objection was raised by John O'Donnell, J. Van Sicklen and other farmers, who appeared before the board and opposed the creation of a lighting district. They asserted that the lights would enable thieves to visit their fields and steal the crops.

ELECTRIC RAILWAYS.

A member of the Cicero Town Board is quoted as authority for the announcement that the Lake Street "L" company of Chicago has promised to extend its elevated structure to Harlem avenue, a distance of about three miles from its present terminal, on condition that the board shall grant the 50-year franchise which is asked for by the company. This extension is two miles greater in length than any which the Lake Street "L" people have talked of lately.

A syndicate of New Yorkers has been looking into the feasibility of a scheme to construct an electric railway from Cape Charles, Va., to the extreme point of the peninsula, a distance of 15 miles. A careful survey of the country has been made by engineers, and an estimate of the cost will be submitted to the syndicate. It is the idea of those at the head of the enterprise to couple an electric plant for the purpose of furnishing Cape Charles City and the New York, Philadelphia and Norfolk railroad with lights.

The recently completed street car line in Cedar Falls, Iowa, running from the heart of the city to the State Normal School at its southern border was formally opened December 14th with a general public celebration. All business houses were closed and speeches were made by Mayor Melendy and President Seerley of the school. A salute of 13 guns welcomed the first car over the line and two bands furnished music. The Patton motor which is employed is the invention of W. H. Patton of Chicago. It is said to work admirably, and the daily expense of operating the line, it is claimed, will be much less than by any other system.

It is believed in Jamaica, L. I., that the promoters of the Cross-Country Trolley company are looking ahead to consolidation with the Nassau electric railroad of Brooklyn. The lines which the Cross-Country company intends to build will reach within a short distance of some of the streets for which Patrick H. Flynn is now trying to get franchises from the Brooklyn Board of Aldermen. The Queens County road is having less trouble in getting its franchises than Mr. Flynn has experienced. The Queens County supervisors and the town authorities of Flushing and Jamaica have already given the road franchises for all the streets for which they have asked.

A trolley car on the North Hudson County line was approaching the ferry in Hoboken at 6:30 o'clock December 1st, when the motor fuse burned out and the car came to a stop on the elevated structure near Jefferson street. A car following was stopped near the disabled one, while an investigation was being made to find the cause of the trouble. A third car going down the steep incline crashed into this one, and the collision jammed the second car up against the first one. The glass in the three cars was smashed, and the rear platform of the second car and the front platform of the third car were twisted and badly damaged. The passengers in the three cars escaped with slight injuries, but the motorman of the last car, Robert McAlevey, 23 years old, was severely injured, and was removed to St. Mary's Hospital in an ambulance.

POWER TRANSMISSION.

An important concession has been granted a German engineer, Hugo Luther, in the exclusive right to use the rapids of the Danube between Brnitza and Kladovo for the production of power during the next 99 years. At the same time, the right was granted him to extract coal, iron ore, copper, lead, silver, gold, etc., from the earth in the east of Servia, and to cut wood and to build the workshops that might be necessary in the accomplishment of his designs.

The concessionary is only bound to observe certain government regulations, and is exempted from taxes and customs duties for 30 years. It is estimated and the falls of the Danube have about 200,000 horse power.

TELEPHONE.

The Elgin Telephone company has completed connection with the Automatic Telephone company of Rochester, Minn.

F. A. Swartwood and others at Waseca, Minn., are taking steps to form a stock company and put in a telephone exchange.

Denison, Ia., voted to grant a franchise to the Iowa Telephone company, the vote being 94 to 57. A local company, headed by Dr. Philbrook, will soon ask a franchise.

The Southern Maryland Telephone company has completed its line between Lanham's station and Hyattsville, and communication is established between those places. There is a plan afoot to extend the line to Bowie and thence to Upper Marlboro, the county seat.

The Bell Telephone company has increased its rates in Alabama to $36 and $46 per annum, the former price for residences and the latter for business houses. These rates are subject to a discount of $6 for quick payment. The people think these rates too high and are kicking. A movement is now on foot to organize a new company, and it is meeting with general co-operation. The matter is in the hands of active and energetic men, and it seems to be the generally accepted verdict that it would be much better for the Bell people to accept a lower rate than to precipitate another telephone war.

The permit issued to the Chesapeake and Potomac Telephone company for the erection of poles on Wyoming avenue, in Washington, D. C., has been recalled. This was the outcome of a lively scene on Wyoming avenue one evening last week, when a large force of men worked industriously by moonlight to get the poles in position, presumably before the citizens could make objections. The work was not begun until nearly dark, and the men were digging holes rapidly when several of the residents of that section who object to overhead wires hastily called upon Commissioners Wight and Black and secured an order putting a stop to the proceedings. The police department was notified, and when officers reached Wyoming avenue they found several wagons unloading poles along the curb line near the holes. After some discussion with the police the workmen withdrew.

At the annual meeting of the stockholders of the Home Telephone company, Monday evening, December 6th, at Fort Wayne, Ind., the report of the officers for the year just closed showed a continually increasing business. There are now 1,295 telephone instruments in use by the company's subscribers, and additions to the list are being made every day. The following board of directors was elected: George W. Beers, Charles Bash, Charles McCulloch, John W. Sale, Samuel M. Foster, Charles D. Law, William J. Vesey, Charles F. Pfeiffer, Louis Fox, Christopher Hettler, Charles Falk, A. S. Coverdale, John P. Evans, Leopold Freiburger and Max B. Fisher. The new board of directors consists of 15 members, six more than the former board. It was deemed advisable to increase the number of directors in view of the constant enlargement of the service, and for better attention to the details of the business. On Wednesday evening, December 8th, the board organized by electing officers as follows: President, George W. Beers; vice-president, Charles S. Bash; secretary, John W. Sale; treasurer, Charles McCulloch. These officers, with John P. Evans, constitute the executive committee, having control of the business.

ELECTRICAL SECURITIES.

The Brooklyn Rapid Transit company reports gross earnings for November of $433,703, an increase of $12,243 as compared with the same month last year.

The gross earnings of the West Chicago street railroad for the week ended December 2d were $70,219, against $66,466 for the same week last year, an increase of $3,753, or 5.64 per cent.

The North Shore Traction company reports gross earnings for October of $122,284, an increase of $10,458 as compared with the same month of last year, and net $50,395, an increase of $5 511.

The New York City and Queens County Electric Light company of Newtown, Queens County, was incorporated on December 9th with a capital of $250,000, to furnish electricity for public and private purposes in Greater New York and in villages of Queens County. The directors are John Welz, Charles Zerwick, Anton Newburger, Siegbert Balaban of Brooklyn, and John Niederstein, Jr., of Middle Village, L. I.

The Bridgeport Traction company reports gross earnings for November of $25,765, an increase of $1,924 as compared with the same month of last year, and net $12,196, an increase of $1,638. For the five months ended November 30th the gross earnings were $145,873, a decrease of $1,227 as compared with the corresponding period of last year, and net $73,576, an increase of $9,443. Fixed charges were $35,222, leaving a surplus of $38,354, an increase of $9,444.

The Columbus Street Railroad company reports gross earnings for November of $49,747, an increase of $1,710 as compared with the same month of last year, and net $26,303, an increase of $2,010.

MISCELLANEOUS.

The large agricultural implement factory of Deere & Co. of Moline, Ill., will soon be equipped for electrical operation. Five 100 horse power motors and two of 75 horse power each will be required.

The report of the labor commissioner of North Carolina will show that there are 22 electric light companies in the state, eight telephone companies, 13 telephone exchanges and seven electric street railways.

United States Minister Newel reports from the Hague that it has been ordered that ventilators, exhausters and bellows which are worked by a steam, gas, petroleum or electric motor only, and are used in factories and on ships, and only in exceptional cases elsewhere, may henceforth be admited free of import duty in the Netherlands, but that ventilators for ordinary purposes and not worked by the aforementioned motive powers shall remain subject to the existing duty.

Reports from Chile indicate that a strong syndicate composed of English and German capitalists is in charge of electric lighting of Santiago and of the electric railways in service in the city. The motive power will be taken from the River Maipo. Some 26,000,000 marks ($6,188,000) are already invested in the enterprise, and the work will be begun at once. There are a number of water powers in Chile having a fall sufficient to develop electric power, which will doubtless be utilized in the development of national industry.

TRADE NEWS.

The Electric Appliance company has been appointed exclusive Chicago agent for Holm's "Tesoline" commutator compound, manufactured by the Boiler Expurgator company.

The Williams & Abbott Electric company of Cleveland, Ohio, has just booked an order from the American Electric Telephone company, Chicago, for magneto bells, which is said to be the largest single order for bells ever placed. The Williams & Abbott company is working a full force 24 hours a day without intermission.

William H. McKinlock and W. C. Camp, agents to the successors of the Metropolitan Electric company of Chicago, have taken a five-story and basement building at 175 Randolph street, where they will carry on the business of electrical supplies. Their increased facilities at this location promise better attention to their large list of customers. Those interested in electrical matters of any kind are invited to call and inspect the new store. The mammoth catalogue of the Metropolitan Electric company will be available, and the customers of this firm can use the catalogue numbers and trade words as usual.

The American Rheostat company of Milwaukee has enjoyed a rapid growth since its incorporation in the spring of 1896. The directors of the company lately found it necessary to vote an increase of the capital stock to $25,000, to enable the company to take care of its constantly increasing business. Its officers are all progressive men and have been untiring in their efforts to make the business a successful one, and the popularity of the American rheostats is the result of their endeavors. It is said that some of the largest motor manufacturers in the country prefer the American rheostat to all others, and accordingly buy their supplies exclusively of this company. The officers of the company are as follows: Frank R. Bacon, president; F. E. Herdman, vice-president; J. Gilbert Hickcox, secretary and treasurer. A finely equipped plant will shortly be erected and the factory will then be moved from its present quarters. The company expects then, with its improved facilities, to materially increase its output.

The Dobbie Foundry and Machine company of Niagara Falls has just completed eight of the largest iron castings ever made in that city. These castings are struts or columns to be placed in the extension of the Niagara Falls Power company's wheel-pit as braces for the walls. The columns are hollow, 12 feet long and 30 inches wide at the widest part. They are made with ribs to give them bending strength, and in the bases are iron plates to prevent the interior filling with dirt or undesirable material. The ribs are two inches wide by four inches deep. The bases that will support the columns will be fastened with anchor bolts to the walls on each side of the pit, and the columns will rest on a lip at the lower edge of the base. The columns weigh six tons each, while the total weight of the bases is 11,705 pounds. The bases are 3½ feet square and 18 inches high. When the columns and bases are in position they will be made more substantial by a rust joint. In all, about 20 of the columns will be used.

The Dayton Globe Iron Works company of Dayton, Ohio, has just completed the installation of four pairs of 42-inch new American turbines and two single 25-inch turbines for the Helena Water and Electric Power company at Clasoit station, Montana. The four pairs of 42-inch wheels are guaranteed to develop 4,000 horse power under 26 feet working head, and this power is to be transmitted electrically to Helena, Montana, 15 miles distant, to be used for driving smelting works and numerous other industrial works. The two 25-inch turbines are to drive exciters. The Helena Water and Electric Power company has about completed its dam across the Missouri River and the immense pipe line leading to the turbines, and when this is completed it will have one of the largest and finest water power plants in the country.

BUSINESS.

The Central Telephone and Electric company of St. Louis has just closed contracts for 50 telephones and a 60-drop switchboard for Hamilton, Mo., and has shipped all construction material for exchange of 100 subscribers and county lines of over 100 miles to the Cape Girardeau County Telephone company.

New schedules give the Pennsylvania Short Lines increased facilities for a quick and pleasant trip from Chicago via Cincinnati and via Louisville to Florida and resorts in the South. Full details for the asking. H. R. Dering, assistant general passenger agent, 248 South Clark street, Chicago, is the person to address.

A trolleyless electric railroad may be seen in daily operation on Adams street, Chicago. It is said that no franchise has been given for this road, and the methods adopted to secure the permit to operate it are not clearly understood. No passenger has thus far been "rung up." For further particulars see the window of the Central Electric company.

One of the latest specialties of the Electric Appliance company is the Ham sand-box for electric and other street cars. The device does not supply the sand to the track by means of a valve; instead, the sand is pushed off a little shelf by an oscillating finger which is entirely controlled by the motorman. In this way the sand is delivered only as wanted and there is no chance for a valve to become stopped up or blocked open so that the sand will run continuously, which means a saving in sand as well as better results, as too much sand is just as bad on the track and on the wheels as no sand at all. These boxes are immensely popular wherever used, and the Electric Appliance company is so confident of the success of the device that it is offering to furnish sample pairs on trial wherever a customer will put them on a car and give them a thorough test.

For isolated plants the General Electric company has recently issued an incandescent lamp catalogue, which is something of a departure and which should be of special interest and value to lamp users. This catalogue contains descriptions of the class of lamps used by isolated station plants. The omission of all other types of lamps has made the catalogue a simple, concise pamphlet. It is something more than a catalogue, in that it contains several opening chapters of special value to lamp users, discussing improved methods of manufacture and showing how important special experience and facilities are in the production of the highest quality of incandescent lamps. Following this the subject of selection of lamps is discussed, with the idea of assisting the customer to obtain the lamp best suited to his conditions. Then an account is given of the requirements for the proper use of lamps and a pertinent example figured out showing the saving to be effected by proper lamp renewals. Descriptions of standard lamps as used by isolated plants are given, accompanied by full-sized illustrations of the lamps. Among others the catalogue contains an account of 250-volt lamps. The catalogue is excellently gotten up, typographically, and contains a folder giving prices of the various types of lamps. The General electric company has endeavored to send copies of this catalogue to every isolated plant in the country, and will be glad to furnish copies to any plant or customer desiring the same. It is intended that this treatise shall be in the hands of every purchaser of incandescent lamps and retained as a book of reference.

The Willard Electric and Battery company has been absorbed by Sipe & Sigler, and the manufacture of the Willard storage battery will be henceforward conducted on an extensive scale. The members of the firm are still young men, and they are well known for their enterprise. In the deal that has just been consummated Theodore A. Willard, the inventor of the battery which bears his name, and H. M. Hawley have become members of the firm, and the business will hereafter be conducted under the name of Sipe & Sigler. This deal was brought about because the demands for the Willard battery far exceeded the capacity of the Willard Electric and Battery company to supply. The manufacture and sale of the batteries will be conducted in the Sipe & Sigler power building, which is one of the finest and most perfectly appointed in Cleveland. It contains six stories and a basement, and each floor is

35 feet by 105 feet. The entire building will be devoted to the manufacture of the Willard storage batteries of all types and sizes, each one adapted to its own particular use. The basement will contain the power plant and a storage battery for the lighting of the building and for supplying of power. The first floor will be devoted to the electro-chemical process of forming; the second to the offices, laboratory, drafting and engineering departments; the third to assembling and kindred operations, while the fourth and fifth will be equipped with special machinery for the manufacture of the plates and other parts, and the sixth floor will be devoted to the manufacture of the concentric form of Willard battery, which has sprung into popular favor owing to the many advantages of its peculiar and original construction. The building was designed especially for fine manufacturing purposes by Sipe & Sigler, and is especially well suited for it, being perfectly lighted from all sides.

Rumors have been circulated of late to the effect that the Westinghouse Electric and Manufacturing company was to have a branch establishment near Buffalo, N. Y. Upon investigation at the Pittsburg office of the company, it was learned that this was not the case. It is probable that this rumor obtained currency through the fact that the Westinghouse people have received many orders for machinery for Niagara Falls, Buffalo and vicinity, and shipments of these goods are constantly going on. Among the orders which the Westinghouse company received from that territory recently may be mentioned the following: The Cataract Construction company contracted with the Westinghouse people for an addition to the power station, consisting of five 5,000 horse power generators of the same pattern as the three installed at present; also exciters, representing a capacity of 675 horse power, and the switchboard with necessary appliances for controlling the five 5,000 horse power generators. The Niagara Falls Hydraulic Power and Manufacturing company some time ago contracted with the Westinghouse Electric and Manufacturing company for six 750 horse power direct current generators, 300 volts, 250 revolutions per minute. These generators will be directly connected to Leffel turbines, and will be used for generating current that will be supplied to the aluminum factory of the Pittsburg Reduction company at Niagara. The Westinghouse company has constructed two 300 horse power two-phase induction motors for the Buffalo and Niagara Falls Electric Light and Power company. These motors will be used for driving alternating current generators, direct current generators and arc machines. The Niagara Electro-chemical company has contracted for a large increase in its transformer station, located above the power house of the Niagara Falls Power company, consisting of three 235 horse power two-phase rotary transformers and one 175 kilowatt rotary transformer supplying current for the reduction of metallic sodium from caustic soda. In addition to these transformers, the Westinghouse company is also making for the same company 800 horse power in air-cooled oil converters, consisting of six 133 horse power converters, 3,000 alternations, which will supply current for the rotaries. The Acetylene Light and Power company has ordered two 1,000 horse power water-cooled oil converters, of 3,000 alternations, primary 2,200 volts, secondary 100 volts. These converters will supply current for arc furnaces for the manufacture of calcium carbide. The Mathieson Alkali company contracted with the Westinghouse company some time ago for a number of rotary transformers, induction motors and oil converters which were recently installed and consist of eleven 165 horse power rotary transformers, several small induction motors, twenty-two 82½ horse power oil converters, four 33½ horse power oil converters and two 13½ horse power oil converters. These facts are the best evidence of the growing use of electrical apparatus at Niagara Falls, occasioned largely by the erection of the large power station of the Cataract Construction company, the generators for which were installed by the Westinghouse Electric and Manufacturing company.

ILLUSTRATED ELECTRICAL PATENT RECORD.

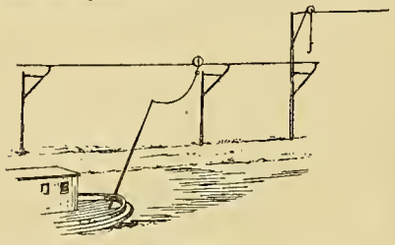
Issued December 7, 1897.

592,872. Electric Soldering Iron. Frank H. Harriman, Hartford, Conn. Application filed April 17, 1897.

A soldering head constitutes one terminal of an electric circuit, a conducting shell surrounds and insulates it from the stem of the soldering-head and is filled with a comminuted carbonaceous material, and constitutes the other terminal of the circuit, and a handle is connected with the soldering-head.

594,879. Potential Switch. John D. Ihlder, Yonkers, N. Y. Application filed October 15, 1896.

A switch having two sets of terminals, a cup-shaped housing inclosing the magnet, an armature thereon having a lug, a lever mounted on the housing and having a catch engaging the lug on the armature, the lever being under stress of a spring.



NO. 594,913.

594,882. Electric Cable. John H. Kelman, Pittsfield Mass. Application filed September 25, 1897.

A cable consisting of several conductors separately coated with a continuous coating of varnish hardened by oxidation, and a covering holding the conductors together in close proximity.

594,913. Trolley Connection for Canal Boats. Frederick J. Shewring, Toronto, Canada. Application filed March 11, 1897.

A trolley system for canal boats is described, consisting of a main circuit wire, a trolley wheel mounted on the main circuit wire, a vertical frame for the trolley wheel composed of two sides united at the top, an eye connected to the top of the sides, a banger depending from one of the sides below the wheel, a horizontal extension for the banger projecting under the vertical axis of the wheel, a vertical extension depending from the horizontal extension, a balance connected to the end of the vertical extension, a circuit wire elevated above the main circuit wire at canal junctions to allow of the free transit of the boats passing beneath, a trolley wheel mounted on the elevated circuit wire, a hanger depending from the trolley wheel having a hook shaped end to engage the eye of the principal trolley wheel.

594,928. Electric Arc Lamp. Haydn M. Baker, Jr., and Arthur W. Fox, Brooklyn, N. Y. Application filed February 24, 1897.

The holder of an arc lamp is provided with a pivoted lever carrying a revolving engaging wheel, in combination with the feed screw, and also provided with a lever for tripping the wheel lever, the axis of the revolving wheel and of the feed screw being parallel.

594,932. Terminal for Electric Conductors. William P. Booth, South Bend, Ind. Application filed December 16, 1896.

A plug having multiple conducting contacts is mounted on one side of a body of insulating material, and is adapted to be inserted between resilient conducting strips and electrodes.

594,944. Electric Switch. Frederick A. Gilbert, Brookline, Mass. Application filed December 18, 1896.

A binding post for electric wires has an opening for the wire, an offset binding screw to act upon one side of the wire, and a second binder to bear directly upon the top of the wire.

594,946. Controller for Motors and Brakes of Electric Cars. Adolphe Grossman, New Orleans, La. Application filed August 31, 1897.

A mechanism for controlling the motor and brake of an electric car comprises a rotary brake staff, a handle so connected with the staff that it will turn in one direction with the staff and in the opposite direction loose on the same, a gear wheel loosely mounted on the staff, a suitable means for holding the gear wheel against casual rotation, suitable means for detachably connecting the gear wheel with the handle, and a rheostat or switch shaft connected by gearing with the gear wheel.

594,979. Telephonic Selective Signaling. John A. Barrett, Brooklyn, N. Y. Application filed March 1, 1897.

The circuit controller consists of a plurality of keys adapted to introduce in the circuit prescribed polarities and distribution of the current supplied by the battery; motor signal receivers consist of a plurality of coils in a closed circuit upon an iron ring in such relation to the main circuit that upon the manipulation of any key two definite predetermined consequent poles of opposite polarity differing for each key will be selectively established in the ring, and a rotary polarized magnet in inductive relation with the ring is adapted to arrange itself in line between the established poles.

594,998. Conduit for Electric Wires. Robert W. Lyle, Perth Amboy, N. J. Application filed October 1, 1897.

A conduit for electric wires having longitudinal and transverse scorings in its body to facilitate the removal of sections thereof.

595,004. Telephone Circuit. George K. Thompson, Malden, Mass. Application filed July 23, 1897.

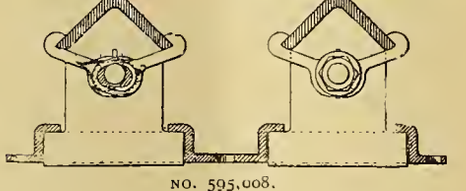
One claim is given: The combination of a sub-station circuit provided with spring-jacks at the switchboard sections and adapted for the operation of automatic signals, current in the line from a central source being determined by the telephone switch at the sub-station, a line lamp signal, a controlling device therefor, and a circuit-controlling device and test circuit, the conductors of said circuit terminating at the poles of a battery, with a cord circuit comprising three conductors, a bridge between the conductors including said battery, and supervisory lamp signals in one, and electro-magnets for controlling the same in another of the said cord conductors, whereby upon the removal of the telephone from its switch at the sub-station the line signal is lighted, and upon the insertion of the answering plug the line signal is extinguished, a test circuit established, a supervisory signal lighted and its rays shielded.

595,008. Electric Railway. George Westinghouse, Pittsburg, Pa., and William Chapman, Washington, D. C. Application filed October 31, 1896.

An electric railway provided with a plurality of lines of sectional, inverted, trough-shaped contact rails, in which the sections are insulated from each other, stationary insulating supporting blocks for the rail sections and clamps for holding the sections against lateral displacement.

595,016. Electrical Igniter for Gas Engines. Benjamin W. Grist and Edmund Cellison, Philadelphia, Pa. Application filed August 21, 1896.

An electrical igniting device for gas or other explosive engines is described, having two normally separated and oscillatory electrodes, a spring for each electrode, connections from the engine for moving one into contact with the other and an automatic releasing mechanism, in combination with means for limiting the motion produced by the springs, and so placed as to allow the contact to be broken.



NO. 595,008.

595,078. Multiple Circuit Block. Duny A. Schutt, Peru, Ind. Application filed April 16, 1897.

A circuit block for use in making branch electrical connections consists of two or more sections of insulating material secured together by metallic bars at the back, main-wire sockets with fusible electrical connections to the bars, and branch connections through the block and to binding screws at the side.

595,081. Armature for Dynamo-electric Machines. Sidney H. Short, Cleveland, Ohio. Application filed March 12, 1897.

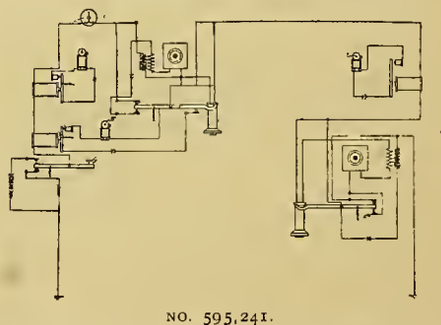
A separating lamina for a dynamo-electric armature having peripheral teeth, the ends of which are bent at right angles.

595,086. Electric Elevator Controller. Charles M. Weymann, San Francisco, Cal. Application filed January 27, 1897.

There is the combination with an electric motor and an elevator mechanism moved thereby, of a mechanism comprising solenoids having movable cores and mechanism actuated by the cores, whereby contacts are produced and the direction of the motor first established, a controlling device whereby both armature and field resistance are varied proportionately to the desired motor speed, and an automatically operating device comprising an electric clutch within the circuit, which is established through the solenoids and intermediate mechanism, whereby the controller is disengaged and returned to its normal position.

595,089. Third Rail Insulator. Albert Anderson, Boston, Mass. Application filed July 23, 1897.

A metallic hood is provided with longitudinal sockets on its inner side, and a metal bolt has its head and shank enveloped by a covering of insulating material, longitudinal ribs on the insulated head engaging the longitudinal sockets in the hood, and a base to which the bolt is secured.



NO. 595,241.

595,132. Secondary Battery. Ralph Ashley, Port Republic, N. J. Application filed October 9, 1896. Renewed July 17, 1897.

In a secondary or storage battery the combination is claimed with the cell, the negative electrodes located therein, consisting of the U-shaped conducting frames, the series of superimposed troughs provided with integral end pieces, and the conductors located in the troughs and their ends connected with the frame of the positive electrodes, consisting of a number of superimposed lead plates having their ends bent backward onto and secured to the main portion, so as to form spaces between the plates.

595,224. Underground Trolley System. Louis E. Walkins, Springfield, Mass. Application filed May 17, 1897.

An underground trolley system for electric railroads is described, comprising a conduit, suitable frames for supporting the conduit, rails supported on the frames, a cover for the conduit secured to the edges thereof and having a continuous longitudinally central slot therein, an insulating material for lining the conduit and for forming longitudinal partitions therein, supports for the cover between the top of the partitions and the cover, guard plates of insulating material extending from the under side of the cover near opposite edges of the slot downward to a point beyond the upper edge of the partitions, insulated trolley rails on the partitions and the under side of the cover, a trolley carriage for the rails having trolley arms extending therefrom upward through the slot in the cover for connection with a motor of an electric car, line wires in separate compartments of the conduit, and connections from the line wires to the trolley rails on one of the partitions and from the trolley carriage to a motor and return, and from the trolley carriage to the rails on the other of the partitions.

595,238. Armored Conduit. Edwin T. Greenfield, New York, N. Y. Application filed July 27, 1897.

An armored conduit consisting of a flexible interior insulating tube and one or more spirally wound layers of metal secured thereto is described.

595,241. Central Station Combined Telegraph and Telephone System. Arthur C. Robbins, San Francisco, Cal. Application filed March 26, 1897.

An improved telegraph and telephone signal system is described, consisting of a central station, a fulcrumed lever at the station, a suspended removable receiver and contacts at opposite portions of the lever alternately made and broken by the suspension or removal of the receiver, an alarm and a local battery circuit at the central station for operating the same, a relay actuated by the main-line current and controlling contacts in the local circuit, and an independent contact with which the lever engages, the last-named contact being closed when the receiver is suspended and open when the receiver is removed.

Western Electrician.
EVERY SATURDAY.
Vol. XXI. CHICAGO, DECEMBER 25, 1897. No. 26

Decorative Holiday Illumination In Chicago.

During the holiday season it is customary for merchants in the larger cities throughout the country to make a special display of their wares in the most attractive manner possible, hoping thereby to catch the eye and please the fancy of the multitude of Christmas shoppers. In Chicago this practice has grown steadily for several years, and of late electric lighting has entered largely into all these arrangements.

The show windows in the big retail establishments down-town, especially the department stores, are brilliantly illuminated, and in many cases very striking effects are secured. Some of the pictures presented along State street are splendid examples of the perfection attained in the window-dresser's art. For instance, one large department store has a scene in which hundreds of dolls, prettily attired and each bearing a miniature incandescent lamp, throng the approach to a lighthouse. The subdued effect of these lights is really artistic.

The central feature in the display of one of the largest retail houses on State street was an arrangement of peacock plumage concealing incandescent lamps. This was pronounced one of the most attractive windows in the city.

All the big stores and the little ones, too, for that matter, between Randolph and Congress streets make generous use of incandescent lamps in their windows, with the result that State street between these points is bathed in a flood of light.

Of course there were many special displays, and some of them were unusually striking. The plan of switching lights in and out of circuit at regular intervals is still in favor, and illuminated revolving signs seem to be more popular this year than ever before.

A very pretty effect was produced by the Chicago Cloak company, which had a unique distribution of incandescent lamps in its show window outlining an auger. The picture on this page, Fig. 1, gives a good idea of the arrangement.

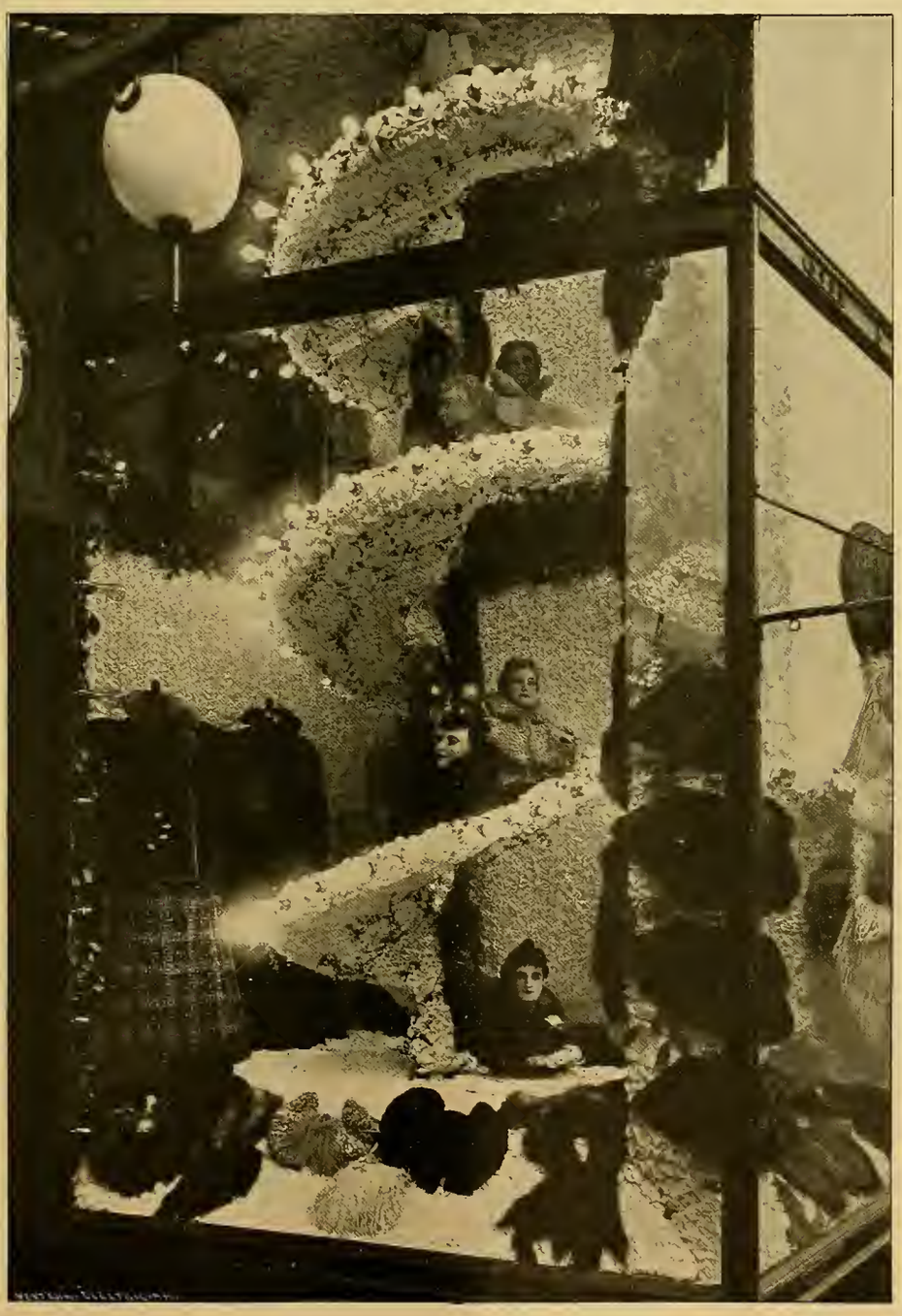


FIG. 1. DECORATIVE HOLIDAY ILLUMINATION IN CHICAGO.—CHICAGO CLOAK COMPANY'S WINDOW.

Probably the most attractive electrical exhibit was that made by the Chicago Edison company in the window of its Adams street building. Fig. 2 is a photographic representation of this display. It is composed principally of incandescent lamps, plain and colored, in all sizes, from miniature to those for commercial use, and affords an object lesson in the use of these lamps for signs and special decorations.

In many other parts of the city, especially upon West Madison street, the illumination of show windows was made on an unusually large scale this year, and here, too, many attractive displays are presented.

In evidence of the fact that electricity plays an important part in all these plans, it is mentioned that the Chicago Edison company's maximum load during the present week reached a higher point than ever before in the history of the company. This is explained by the fact that most of the large department stores in the down-town retail district which are making such an unusual display this year are taking current from this company. One day's business may be taken as fairly illustrative of this fact. On Monday, December 20th, the maximum load on all the stations of the Chicago Edison company was 8,965 kilowatts, 13,457 indicated horse power. Of this the low-tension service comprised 7,500 kilowatts, and in the down-town district 43,200 amperes was distributed. This load is about 30 per cent. greater than that carried in the corresponding period of last year.

An electric light franchise was granted at Spring Green, Wis.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the Western Electrician.]

The Duluth Telephone company is the first telephone company in the state to file a report of its gross earnings with the state treasurer, under the law for the taxation of gross earnings, passed last winter. Its earnings are placed at $27,700 for business within the state. No account is taken of the interstate earnings. An opinion will be secured from the attorney-general whether the report, omitting a statement of interstate business, can be accepted.

A telephone line is projected between Traer and Elberon, Ia.

Work is being rushed on the lines of the Wisconsin Valley Telephone company toward Ashland. Arrangements are being made to have exchanges in Hurley, Ironwood and Bessemer. The company has secured 500 subscribers in Ashland, Washburn and Bayfield.

The poles and wires of the Wisconsin Valley Telephone company have reached Trempealeau, Wis., making the fifth telephone company in that little place. It is believed the American Telegraph and Telephone company will run through Trempealeau, giving it six different telephone companies to do business with.

It will not be long until Spokane, Wash., will be one terminus and San Diego, Cal., the other of the longest telephone line in the world. The line will be 1,829 miles long, exceeding the line from Omaha to Boston about 129 miles. The gap between Eugene, Ore., and Redding, Cal., is rapidly being closed, and when it is finished the line between the two extremes will be complete.

The Iowa Telephone company has completed a line between Missouri Valley, Ia., and Blencoe.

The Clearfield and Mt. Ayr Telephone company is building toward Des Moines, Ia., and expects to complete the line this month.

The Cumberland Telephone company has been organized at Cumberland, Wis., and will put in an exchange at once.

A telephone line from Lewistown, Mont., or Gilt Edge is in contemplation to connect with the Stephens, Fergus and Hilger ranches.

J. E. Swindlehurst has been granted a franchise at Livingston, Mont., for a local telephone exchange. It will be put in as soon as the weather will permit.

The Fort Madison, Ia., council refuses to allow the Mississippi Valley Telphone company to even run its lines through that town.

The Dwelle Telephone company has completed a line to Zumbro Falls, Hammond, Plainview, Wabasha and Mazeppa, Minn., and connects with Rochester, Winona and other towns.

A telephone company has been organized at Waseca, Minn., with $10,000 capital stock.

The Pin Oak Telephone company is stringing wires for its line between Dubuque, Ia., and Pin

Oak, and expects to have it in operation by December 25th.

A merry war is on at La Crosse, Wis., between the Bell and anti-Bell interests. The American Telephone and Telegraph company has been an applicant for a franchise there, and its original franchise was regarded by the independent company as discriminating against it. So the council agreed that no franchise should be passed that did not contain an anti-discrimination clause; that the long-distance company must treat all local exchanges alike. This provision the American Telephone and Telegraph company refused to accept.

An independent telephone exchange is projected at Mt. Pleasant, Ia.

The Emmetsburg Telephone company of Emmetsburg, Ia., has been incorporated with $10,000 capital stock.

The Sibley County Telephone company has completed its lines between Arlington and Fairfax, Minn.

FIG. 2. DECORATIVE HOLIDAY ILLUMINATION IN CHICAGO.—DISPLAY OF CHICAGO EDISON COMPANY.

The 280 telephone instruments in use at Appleton, Wis., average about 3,000 calls a day.

The Iowa Telephone company is installing in its Des Moines office the four-instrument party-line service. The central is signaled by taking down the receiver with these instruments, and the other telephones on the line are not rung up when anyone is called.

The Mississippi Valley Telephone company announces that it has not given up the fight to secure a franchise in Minneapolis. It says it will possibly be forced to submit the question to the people of Minneapolis at a special election, which it will do if necessary. With this in view the company asks that the contracts signed by Minneapolis persons be extended six months, at the end of which time, if it is not successful, it will retire from the contest. Most of the contracts the company secured expire January 1, 1898.

Mrs. Charles Brierly of Matamoras, Pa., has applied to the board of managers of the Port Jervis electric street railroad for the place of motorman. She is a strong woman, quite good-looking, and is one of three women in this country who have had experience as practical "motormen." The board is considering Mrs. Brierly's application.

Current Rectifier.

Mr. L. Graetz, says l'Industrie Electrique, has invented a rectifier of alternate currents by the aid of a peculiar property of aluminum, when this metal forms one of the electrodes of an electrolytic combination. The inventor has not published the composition of the liquid in the bath, however.

When an aluminum plate forms the anode of an electrolytic bath, the cathode being formed by a plate of carbon or platinum, there will be no passage of current while the electromotive force is below 22 volts. This is then a sort of valve or electrical dam to pressures up to 22 volts. Mounting several similar baths in series, a counter pressure might be maintained which would be practically without limit.

Mr. Graetz's arrangement will be understood by reference to the cut. There are four series of electrolytic batteries, A_1, A_2, B_1, B_2, coupled as shown. The alternator D produces a continuous or rectified current in the circuit R, which is branched or coupled between G and H. On such a branch the phenomena pertaining to a direct current have been realized: the deposition of metal and the running of direct current motors.

The inventor claims that the loss of transformation does not exceed four to five per cent. Mr. Graetz attributes the effect of the aluminum electrode to a phenomenon of electrostatic condensation. When the anode is of aluminum a layer of oxygen or other anion forms at once and acts as a thin dielectric film, partially enfeebling the current action.

The idea of Mr. Graetz had already been presented to the academy by Mr. Pollak through Mr. Lippman, but no one thus far has furnished the results of experiments which tend to show the practical value of the invention.

Big Strain on Telegraph Cables.

[Springfield, Mass., Republican.]

This Austrian domestic agitation may yet be responsible for a breakdown in the trans-Atlantic cables. There is Czwrczek, for instance, the name of a czech of Freiwalden, Silesia, who has lately come into some prominence. It takes a strong piece of machinery to withstand a strain like that.

Power Required for Machine Tools

D. Selby-Bigge of Newcastle-on-Tyne, who has been a conspicuous advocate in England of the use of electricity for driving tools, has dealt with the subject in a paper read before the Cleveland Institute of Engineers. In his paper he gives the following list of the various powers absorbed by shipyard and other machine tools when running light and heavy laden. In many cases a great part of the power is expended in getting the machines under way and keeping them running, irrespective of what work they may be doing.

	Electrical horse power.
Double punch—	
Running light	2
Punching both ends, 1-inch hole, ⅞-inch plate, 28 punches per minute at each end	5
Punch and shear—	
Running light	2
Punching hole as above and shearing ⅞-inch plate, 5½-inch cut, 28 strokes per minute	6.5
Large plate-bending rolls—	
Running light	5.5
Rolling plate, 9-20 inch thick by 4 feet 4 inches wide by 15 feet 6 inches long, endways on (4 feet 4 inches)	6.9
Sideways on (16 feet 6 inches)	12.2
Plate 11-20 inch by 4 feet 8½ inches by 21 inches long, sideways on	19.3
Same rolls lifting and lowering top roll—	
Lifting	8.5
Lowering	7
Forcing 11-20-inch plate down	10
Forge fan—	
For 24 fires	10.5
Angle squeezer—	
Running light	0.8
Squeezing	2.5
Wood-working machinery—	
Small plane	0.8
Tenoning machine	0.8
Band saw	1.5
Cross-cut saw	3.5
Small circular saw, cutting 6-inch pitch pine, hand fed	6.4
Circular saw, 48 inches, sawing 18-inch teak, 65 feet per minute	24
Sawing 4½ feet teak, 25 feet per minute	17.7
Countersinking machine—	
Actual power taken in countersinking	3.5
Riveting machine—	
Running light	1.6
Riveting	3
Wall planer—	
Taking ⅜-inch cut cast-iron	5
Radial drill—	
Drilling 1 1-14-inch hole cast-iron	1.59
Plate planing machine—	
Running light	0.6
Reversing light	1.6
Cutting 1-inch by 14-foot plate	3.1
Stern frame boring—	
Cutting	1.75
Shafting lathe, 18-inch center—	
Running light	0.5
One tool cutting 11-16-inch square cut	1.8
Two tool cutting	2.5
Lathe, 9-inch center—	
3-16-inch cut	0.6
Angle cutting machine—	
Running light	1.6
Cutting angle 6 inches by 3½ inches plus ½ inch	3.5
Winch—	
Lifting 28 hundredweight, single purchase, 50 feet per minute	6.5
Ending machine—	
Running light	1.9
Cutting 4-inch by 4-inch angle	4 to 4.8
Cold saw—	
Running light 24-inch saw	2
Cutting 4-inch by 4-inch angle	4 to 4.5
Air compressor—	
10-inch by 14-inch cylinder, 50 pounds pressure	15 to 23.5
Portable drill—	
When drilling 1-inch hole	1.5
Hydraulic pumps—	
Three rams 3⅝ inches diameter, 4¾-inch stroke, 60 strokes per minute; pressure, 870 pounds; power taken	38
Joiner's shop motor—	
Normal load	14.8 to 22
Machines being driven from this motor—	
One 20-inch plane.	
One circular saw, 24 inches.	
One 30-inch planing and sandpaper machine.	
Electric winch—	
Running light	1.2
Lifting 24 hundredweight, 16 feet per minute	5.6

Mr. Selby-Bigge states that in iron and steel works the powers must be somewhat heavier, and the size of the plant necessary for the driving of the works more powerful. In addition to the ordinary outlying machinery, shops, hydraulic plant, all the small live roller-gear engines, skid engines, capstans, winches, etc., can be advantageously replaced by electric motors. Plate rolls, angle rolls and other similar machines are easily adapted for electric driving.

American Institute of Electrical Engineers.

At the meeting of the Institute in New York, Wednesday, December 15th, about 100 members and visitors were in attendance.

A paper was read by Thorburn Reid of New York on "Sparking, Its Cause and Effects," which is presented elsewhere in this issue. The discussion was opened by Gano S. Dunn, and was participated in by Messrs. Kennelly, Steinmetz and others.

At the close of the discussion W. J. Clarke of New York gave a very interesting and successful exhibition of the Marconi wireless telegraphy. Signals were audibly transmitted between the extreme ends of the parlor and lecture room, the folding doors being closed between them.

At the meeting of the executive commitee in the afternoon the following-named associate members were transferred to full membership: Joseph Sachs, New York, and Robert B. Owens, Lincoln, Neb.

The meeting of January 26th will be devoted to the question of standardizing generators, motors and transformers. The policy of undertaking this work as well as the technical problems involved may be

discussed. Communications upon the subject are invited and may be sent to the secretary in advance of the meeting.

Niagara-Buffalo Transmission Line.

By Orrin E. Dunlap.

The power transmission line running between Niagara Falls and Buffalo has recently been doubled in capacity by the stringing of three additional copper cables. This line is owned by the Niagara Falls Power company, and it was in the fall of 1896 that the first three cables were strung, which, with the three just added, make six cables in all for the transmission of power. The three cables last strung are of the same size as the three original cables, each having 19 strands and each being of 350,000 circular mils. All the power cables are placed on the upper crossarm, three on each side of the pole.

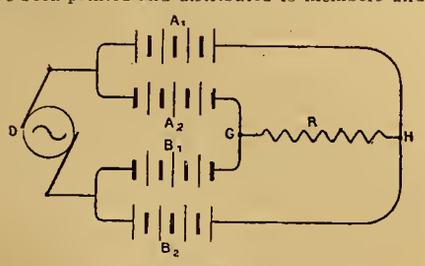
NIAGARA-BUFFALO TRANSMISSION LINE.

The lower crossarm, intended for power cables, is as yet unused. The length of each of the copper cables is about 26 miles, thus in the six cables there are over 150 miles of line if the cables were strung end to end. The number of insulators has likewise been increased to six.

The Niagara Falls Power company has found the demand for power in Buffalo fully up to its expectations, and it has very promptly enlarged the capacity of the transmission line in order to supply the call for current. When the pole line was erected it was built in expectation of enlarging the transmission, and the addition to its capacity has been very rapidly effected. In the transformer station at Niagara Falls men are busy installing seven new transformers to be put in service on the line as called for. Each of these transformers has a capacity of 1,250 horse power, and thus the 10 will represent over 10,000 horse power. These machines are the product of the General Electric company, and have been described in this journal. They will stand in rows of four over the air chamber in the station adjoining the power house. By their use the voltage of the current is raised to about 11,000. The transmission of additional power to Buffalo also calls for an increase in the number of step-down transformers at the Buffalo end of the line, and this increase is being made.

American Street Railway Association.

The proceedings of the sixteenth annual meeting of the American Street Railway association, which was held at Niagara Falls, N. Y., October 19-22, have been printed and distributed to members under



CURRENT RECTIFIER.

the supervision of the secretary, T. C. Penington. This year's report is a volume of 266 pages, containing a comprehensive account of the meeting and banquet and a list of members and visitors present.

In view of the difficulties under which the report was prepared this year, the completeness, accuracy and promptness which mark its presentation are all the more noteworthy. Mr. Penington is deserving of much credit for this work.

Sparking, Its Cause and Effects.[1]

By Thorburn Reid.

Present theories in regard to the operation of commutation and the nature of sparking show considerable progress beyond those of a few years ago. The most important step forward was taken when the reactance of the coil under commutation was recognized as the greatest obstacle to perfect commutation, and the duty of overcoming this reactance was assigned to the electromotive force set up by the cutting of the lines from the field by the coil under commutation. It was also recognized that this must be limited by the available reversal electromotive force.

This was a long step forward, but it stopped just short of a complete explanation of the phenomena involved. This failure was due to an erroneous idea, which has fastened itself on the theory from the start, that injurious sparking was due to the current sparking across the gap between the brush and the receding segment, by reason either of incomplete reversal of the current or of over-reversal.

I shall attempt to show in what follows that sparking from either of these causes may be harmless, and that the real injury is done before the segment leaves the brush.

Taking first the simplest case of commutation, that of a coil of n turns with its ends connected to adjacent commutator segments, we may state the operation of perfect commutation thus:

First, consider a coil which is approaching a brush through which the current is entering the armature from the outside circuit. The brush covers the segment connected to one end of this coil, and half of the brush current is passing through the coil from segment 3 to segment 2 (Fig. 1), the other half from segment 3 to segment 4.

Second, consider this coil receding from the brush, which now covers segment 2, as shown in Fig. 5. Half of the brush current is now passing through the coil from segment 2 to segment 1, the other half passing through the next adjacent coil from segment 2 to segment 3. The current in the coil 3-2 now has the same value under the conditions shown in Fig. 5, as it had before in Fig. 1, but its direction of flow through the coil has been reversed. Between these two positions of the coil with reference to the brush, the whole operation of commutation has taken place, requiring generally but a very small fraction of a second.

Fig. 2 shows the first operation in commutation. The two ends of the coil are now connected through the brush, and the current passing around the left-hand circuit of the armature has two possible paths, the one through segment 2, the other through segment 3. The amount of current which will flow from the brush direct to segment 2 depends on the difference of potential between the brush and segment 2, and on the resistance of contact area of segment 2.

Since the difference of potential of any two points in a circuit is the same through whatever path the current flows, this difference of potential is equal to the algebraic sum of the potentials reckoned from the point of contact of the brush with segment 2 to the point of contact of the brush with segment 3 across this contact and through the coil to segment 2. The difference of potential in the commutator segment need not be considered, as it is negligible. The difference of potential in the brush itself is also negligible.

The difference of potential across the area of contact of segment 3 varies directly with the current flowing across it and inversely with the area of contact. The difference of potential in the coil 3-2 depends on three factors, the CR drop in the coil, the counter electromotive force of self-induction due to change in the value of the current and the electromotive force due to cutting the lines of force of the field. This last we will call reversal E.

The CR drop varies with the current flowing in the coil. The counter electromotive force or inductance drop varies with the rate of change of the current in the coil. Reversal E varies with the rate of cutting of the field lines.

The CR drop at the contact area and the CR drop in the coil both oppose the current, and the inductance drop aids it as long as the current is decreasing. The reversal E may act in either direction, but is usually opposed to the inductance E. Therefore the difference of potential between the brush and segment 2 equals the CR between the brush and segment 3 plus the CR in the coil 3-2, minus the inductance drop in the coil, plus reversal E. It is seen that, as the brush moves over from the position of Fig. 2 to that of Fig. 3, the area of contact of segment 2 increases, while that of segment 3 decreases. Thus the resistance of the current path from the brush to segment 3 and through the coil to segment 2 is continually increasing, while the resistance from the brush to segment 2 direct is decreasing. Therefore the CR drop across the contact area of segment 3 will increase or decrease according as the contact area of current decreases more rapidly.

Thus throughout the period of commutation there is an increasing opposition to the passage of the current through the segment 3, and an increasing facility for its passage through segment 2 due merely to the changes of the areas of contact of the brush with the two segments, and to the consequent changes of resistance.

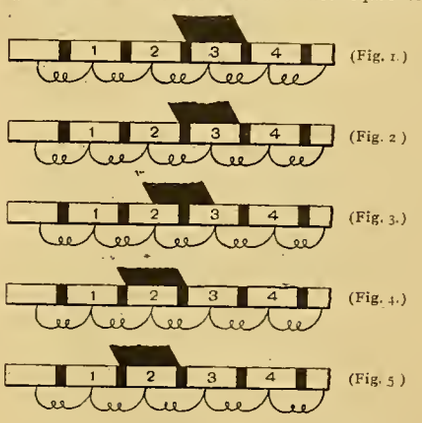
For perfect commutation, which is the case we are considering at present, the impedance of the coil e should always be equal and opposite to the reversal E, as will appear later.

The next period in commutation is that during which the current in the coil is increasing to its final value after having passed through zero.

When the current in the coil is zero, one-half of the brush current is passing through each of the two segments under the brush on the proper assumption that the current divides equally between the two halves of the armature. The CR drop at the contact surfaces of the two segments will then be inversely proportional to the area of the contact surfaces, and the difference between the impedance E and the reversal E will then, as before, be equal and opposite to the difference between the two CR drops at the contact surfaces. It should be noted here, that, although the current in the coil is zero, its rate of change may be considerable, and thus cause considerable inductance E.

While the current in the coil is increasing, the inductance E is in opposition to the current, while the reversal E is in the same direction with the current. Thus while in the first period of commutation, the inductance E prevented the decrease of the current, in this period it prevents its increase. The reversal E on the other hand aids the decrease of the current in the first period, as well as its increase in the second. The increase of the contact surface of segment 2, and the decrease of that of segment 3 still continue to aid the flow of the current from segment 2 through the coil to segment 3, so that the effect of all these varying electromotive forces is just the same throughout this period as throughout the first period, but the resistance of the coil itself, which in the first period aided the decrease of the current, in this period opposes its increase.

Finally, just as segment 3 leaves the brush (Fig. 4) the current in the coil becomes equal to one-



SPARKING, ITS CAUSE AND EFFECT.

half the brush current and no current passes through from the brush to segment 3, and the segment leaves the brush without any difference of potential between it and the brush.

Now consider how the current should vary during the period of commutation, so that the energy of commutation will be developed equally over every part of the contact surface, and so that the amount of energy developed shall be a minimum.

First consider the variation of the current which will satisfy the first of these conditions. This condition will be fulfilled if the current density in every section remains constant as long as the area of contact is changing; for every part of the segment remains in contact with the brush for the same length of time, that is, the time required for that part to pass from the heel to the toe of the brush. Therefore, since every part is receiving energy at the same rate and for the same length of time, the energy developed in each part is equal. While the whole segment is covered, any change in the current density will affect every section equally, so that the current may vary in any way during that period, without causing unequal distribution of energy.

Consider how the current should change so as to develop the least energy. That is, how the current must be distributed between the contact surfaces of the segments so as to develop the least possible amount of energy.

Let R_1 and R_2 be the resistance of the two segments, and C_1 and C_2 the corresponding currents, C being the total current flowing. Then we have for the rate at which energy is being developed at any period:

$$W = C_1^2 R_1 + (C - C_1)^2 R_2 \qquad (1)$$

Differentiating and equating to zero, we have

$$C_1 = \frac{R_2}{R_1 + R_2} C \qquad (2)$$

To determine whether this gives a maximum or minimum value, substitute in equation (1) for C_1 the values $C = 0$ and $C_1 = C$, and we get for $C_1 = 0$, $W = C^2 R_2$ and for $C_1 = C$, $W = C^2 R$. Both these values are higher than that obtained by substituting from equation (2) in equation (1), namely:

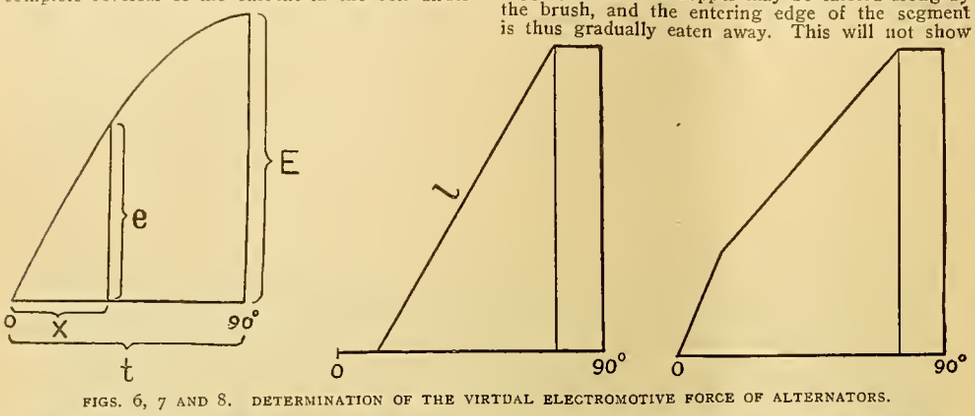
$$W = \frac{R_1 R_2}{R + R_2} C^2$$

1. Read before the American Institute of Electrical Engineers, New York, December 15, 1897.

Therefore that value of C_1 makes W a minimum.

This means that for each position of the brush, the energy developed at the contact surface will be a minimum when the current divides between the segments under the brush in the ratio of their areas of contact. It is seen that under these conditions, the current density remains constant, and that therefore the requirements of equal distribution of energy are also fulfilled.

Perfect commutation may now be defined as a complete reversal of the current in the coil under commutation in such a manner that the portions of the current flowing through the two segments to which ends of the coil are connected shall be proportional to the respective contact areas of the segments.



FIGS. 6, 7 AND 8. DETERMINATION OF THE VIRTUAL ELECTROMOTIVE FORCE OF ALTERNATORS.

It was shown above that $C_2 R_2 = C_1 R_1 + CR$ drop in the coil plus the inductance E in the coil plus the reversal E. If, therefore, the sum of the CR drop of the coil plus its inductance E were always equal and opposite to the reversal E, $C_1 R_1$ would be equal to $C_2 R_2$, which is the condition for perfect commutation as defined above.

Following are some of the various ways in which imperfect commutation may occur, and the manner in which this imperfect commutation causes injury to the commutator:

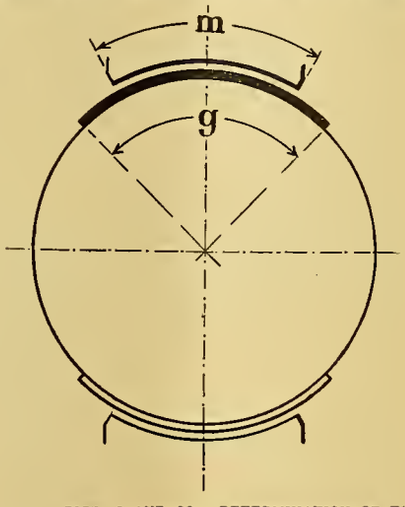
First—Suppose that the current flowing across the contact surface of the receding segment does not decrease as rapidly as the contact surface of that segment decreases. The current density then increases and is a maximum at the last part of the segment that touches the brush. More energy is thus concentrated at that point than at any other, and owing to the fact that time is required to conduct that energy to other parts of the segment, that part will be raised to the highest temperature. This temperature may be high enough to melt, or even volatilize, the copper of the segment, therefore when the brush leaves the segment, the current continues to flow through the film of melted copper, volatilizes it and draws an arc. This arc constitutes the injurious or vicious spark. The removal of the volatilized copper from the receding edge gradually wears that edge away. Reduction of the contact surface thus continually increases the current density, and the arc is formed at an earlier stage of the commutation when the current to be broken is greater, and thus the spark increases in viciousness until the commutator has to be turned down before the machine will run at all.

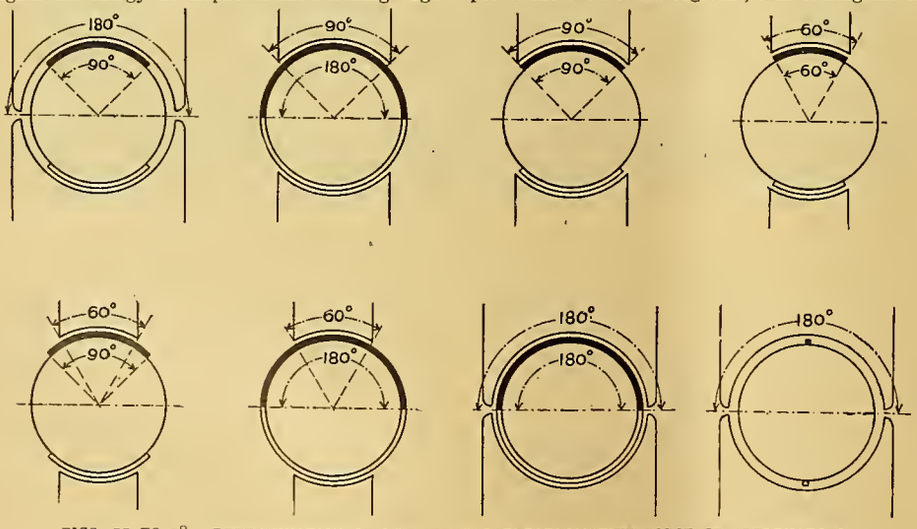
Again the energy developed at the receding edge of the segment may not be sufficient to melt the copper. In this case the current to be broken when the segment leaves the brush will jump across from the brush to the segment. This spark has no deleterious effect, since most of its energy is developed in the space between the segment and the receding brush, instead of being concentrated at the edge of the receding segment. This spark is of the same bluish color as that of the Ruhmkorff coil, by which it may be distinguished from the injurious spark, which is yellow.

Second—Suppose that the current flowing across the contact area of the entering segment increases more rapidly than the contact surface increases. The current intensity in that part of the segment then increases, and more energy is concentrated at this point than at other parts of the segment, and it will accordingly be raised to a higher temperature. If this temperature is not high enough to melt the copper, no harm results and there is no spark, since the contact is not broken at that point. If, however, the temperature produced is high enough to melt the copper, the melted copper may be carried along by the brush, and the entering edge of the segment is thus gradually eaten away. This will not show by any sparking immediately, but it will eventually cause a spark to appear in the following manner: The eating away of the entering edge of the segment gradually reduces the area of the entering segment and thus increases the resistance of that segment. This delays the decrease of current in the receding segment, and the current density in both segments increases until the temperature gets high enough to produce a spark as described in the first case of imperfect commutation. Another incidental injury that may occur is the deposition of the melted copper at the back of the segment, thus raising the surface of the segment at that point, and this, together with the depression of the surface at the front of the segment, would cause the brush to jump and chatter, which of itself would cause deleterious sparking.

This would explain the cases where a machine runs perfectly sparkless when first set up, but after a time commences to spark, the spark increasing in intensity and deleterious effect and disappearing when the commutator surface has been turned up, only to reappear after sufficient time has elapsed.

[*Continued on page 361.*]





FIGS. 11 TO 18. DETERMINATION OF THE VIRTUAL ELECTROMOTIVE FORCE OF ALTERNATORS.

Determination of the Virtual Electromotive Force of Alternators.[1]

By Karsten Knudsen.

Part II.

In the preceding article the equation for the virtual electromotive force was derived. We will now see how to apply this in some special cases.

Suppose an electromotive force is a simple sine function of the time, we can apply the equation in order to find the virtual electromotive force for this case. It is sufficient to make the integration for one-quarter of a period, or from 0 to 90 degrees over the axis of time.

It may be more convenient to use the equation in the form:

$$E_1^2 t = \int_0^t e^2 dx.$$

We have from Fig. 6

$$e = E \sin x$$
$$e^2 = E^2 \sin^2 x$$

Substituting in the equation:

$$E_1^2 t = E^2 \int_0^t \sin^2 x \, dx$$

but $$\sin^2 x = \frac{1}{2} - \frac{\cos 2x}{2}$$

and $$E_1^2 t = E^2 \int_0^t \left(\frac{1}{2} - \frac{\cos 2x}{2}\right) dx.$$

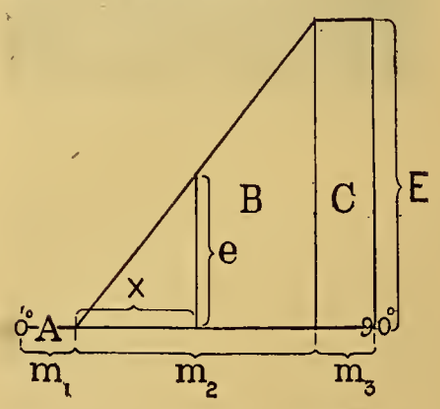
From the time 0 to $t = 90°$ or $\frac{\pi}{2}$;

therefore $$E_1^2 \frac{\pi}{2} = E^2 \left(\frac{\pi}{4} - \frac{\sin 2\frac{\pi}{2}}{4}\right)$$

$$\sin 2\frac{\pi}{2} = 0:$$

$$E_1^2 \frac{\pi}{2} = E^2 \frac{\pi}{4}$$

Hence, $$E_1 = \frac{E}{\sqrt{2}} = .707\ E.$$



FIGS. 9 AND 10. DETERMINATION OF THE VIRTUAL ELECTROMOTIVE FORCE OF ALTERNATORS.

The virtual electromotive force of a sine curve is also .707 × the maximum electromotive force.

In order to determine the virtual electromotive force, the form of the curve must be known, and an equation suitable for general application in regard to the relation between the width of the field-poles and the armature winding is desired.

In using the fundamental hypothesis, which considers the lines of force uniformly distributed between definite limits, we are able to find the height of the ordinates or variable electromotive forces for any width of field-pole and armature winding respectively. In consequence of leakage and spreading of lines of force from the corners of the poles, the curve obtained in practice differs from the theoretical, in that the sharp corners are more or less rounded and the lines which the theoretical figure is composed of are more or less curved. The heterogeneousness of the field becomes less by decreasing the air-gap or increasing the area of the pole-face. The larger the pole-face, and the smaller the air-gap, the more our hypothesis agrees with the truth.

As before stated, the electromotive force obtained from alternators most frequently used in actual practice agrees fairly with the theoretical value. In some cases the difference is only a couple of per cent. lower than the theoretical electromotive force.

In all the cases where $(m + g)$ is equal or less than 180°; or $g = 180°$; or $m = 180°$. the electromotive force between 0° and maximum may be represented by the straight line l, Fig. 7.

If g is less than 180° respectively $(m + g) > 180°$, the electromotive force between 0 and maximum may be represented by the broken line in Fig. 8.

For convenience we may treat these two cases separately, denoting the first case a, and the second case b.

Case A.

Terms: $(m + g) \leq 180°$; or $g = 180°$; or $m = 180°$.

It may be convenient in order to determine the

1. A typographical error in the first article (December 11th) should be corrected. The second paragraph, third column, page 329, should read as follows: "In order to obtain the same amount of work from an alternating current apparatus in the same period of time, through the same resistance (free from self-induction), we have to find an equation that is equal to E_1 and may be expressed in terms of e."

virtual electromotive force, to consider only one-quarter of a period, and divide the x axis from 0° to 90° in three parts; m_1, m_2 and m_3; each expressed in parts of t or 90°, and to find the squares of all the ordinates of A, B and C, Fig. 10.

We have the squares of A = 0; the squares of

$$B = \int_{m_1}^{m_3} e^2 dx; \text{ and in Fig. 10, } \frac{E}{m_2} = \frac{e}{x}; \; e^2 = \frac{E^2 x^2}{m_2^2}.$$

By substituting, the squares of

$$B = \frac{E^2}{m_2^2} \int_{m_1}^{m_3} x^2 dx = \frac{E^2}{m_2^2} \cdot \frac{m_2^3}{3} = \frac{1}{3} E^2 m_2$$

The squares of $C = E^2 m_3$; and the equation for the squares of A, B and C becomes

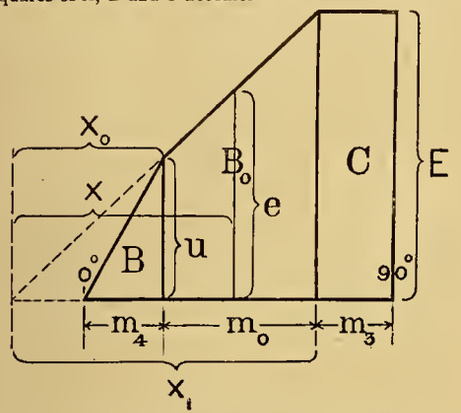


FIG. 19. DETERMINATION OF THE VIRTUAL ELECTROMOTIVE FORCE OF ALTERNATORS.

$$0 + \frac{1}{3} E^2 m_2 + E^2 m_3;$$

and therefore we have:

$$E_1^2 = \frac{\frac{1}{3} E^2 m_2 + E^2 m_3}{m_1 + m_2 + m_3};$$

but m_1, m_2 and m_3 are expressed in parts of 90°; consequently

$$m_1 + m_2 + m_3 = 1.$$

Hence, $$E_1^2 = \frac{1}{3} E^2 m_3 + E^2 m_3 = E^2 \left(\frac{1}{3} m_2 + m_3 \right)$$

or, $$E_1 = E \sqrt{\frac{1}{3} m_2 + m_3} = E \frac{\sqrt{m_2 + 3m_3}}{\sqrt{3}}$$

In the preceding article the expression for the maximum electromotive force was derived, and reads

$$E = NCn \frac{360}{m+s}.$$

Substituting for E we have

$$E_1 = NCn \frac{360}{m+s} \cdot \frac{\sqrt{m_2 + 3m_3}}{\sqrt{3}}$$

The expression for the electromotive force for a continuous current dynamo is

$$NCn,$$

The ratio between the equation for the electromotive force for alternators and that of continuous current dynamos is a coefficient denoted by k;

Hence, $$k = \frac{360}{m+s} \cdot \frac{\sqrt{m_2 + 3m_3}}{\sqrt{3}}$$

If we have p pair of poles, the equation for the virtual electromotive force, in practical unit, becomes

$$E_1 = \frac{pNCn}{10^8} k.$$

C is the total number of conductors in series, N lines of force per pair of poles and n revolutions per second; m_2 and m_3 can be determined by reference to Figs. 9 and 10.

That number of degrees over which the electromotive force is constant for one-quarter of a cycle is

$$\pm\left(\frac{m}{2}\right) \mp \left(\frac{g}{2}\right)$$

consequently, $$m_3 = \frac{\pm\left(\frac{m}{2}\right) \mp \left(\frac{g}{2}\right)}{90} = \frac{\pm g \mp m}{180}$$

and, $$m_1 = \frac{90 - \frac{m}{2} - \frac{g}{2}}{90} = \frac{180 - (m+g)}{180}$$

but $m_1 + m_2 + m_3 = 1$; and we have:

$$m_2 = 1 - (m_1 + m_3).$$

If in the expression for m_1 $(m + g) > 180°$ we will get a negative value, but since in such cases we do not have intervals of no electromotive forces, it follows that m_1 must be 0 for $(m + g) \geq 180°$.

If in the expression for m_3; $m > g$ it reads

$$m_3 = \frac{m-g}{180}; \text{ if } m < g$$

$$m_3 = \frac{g-m}{180}$$

The following examples will illustrate the use of the formulas, in order to determine the coefficient k. The examples relate to, and the formulas required are for, case a:

$$k = \frac{360}{m+s} \cdot \frac{\sqrt{m_2 + 3m_3}}{\sqrt{3}}$$

$m_1 = \frac{180 - (m+g)}{180}$; $m_1 = 0$ if $(m+g) \geq 180°$

$m_2 = 1 - (m_1 + m_3)$

$m_3 = \frac{g-m}{180}$ or $\frac{m-g}{180}$ if $m > g$

$s = g - m$; $s = 0$ if $m \geq g$

m and g = number of degrees pole-face and armature winding inclose respectively.

In Fig 11, m = 180°; g = 90; therefore, $m_1 = 0$; $m_2 = \frac{1}{2}$; $m_3 = \frac{1}{2}$; s = 0,

and $$k = \frac{360}{180} \cdot \frac{\sqrt{\frac{1}{2} + \frac{3}{2}}}{\sqrt{3}} = \frac{2\sqrt{2}}{\sqrt{3}} = 1.635$$

In Fig. 12, m = 90°; g = 180°; therefore, $m_1 = 0$; $m_2 = \frac{1}{3}$; $m_3 = \frac{2}{3}$; s = 90, and k is consequently the same as for Fig. 11 = 1.635.

In Fig. 13, m = 90°; g = 90°; therefore, $m_2 = 1$; $m_3 = 0$; s = 0

and $$k = \frac{360}{90} \cdot \frac{1}{\sqrt{3}} = \frac{4}{\sqrt{3}} = 2.308.$$

In Fig. 14, m = 60°; g = 60°; therefore, $m_2 = \frac{2}{3}$; $m_3 = 0$; s = 0

and $$k = \frac{360}{60} \cdot \frac{\sqrt{\frac{2}{3}}}{\sqrt{3}} = 2\sqrt{2} = 2.828.$$

In Fig. 15, m = 60°; g = 90°; therefore, $m_2 = \frac{2}{3}$; $m_3 = \frac{1}{6}$; s = 30,

and $$k = 4 \cdot \frac{\sqrt{\frac{2}{3} + \frac{3}{6}}}{\sqrt{3}} = 4 \cdot \frac{\sqrt{\frac{7}{6}}}{\sqrt{3}} = 2.494.$$

In Fig. 16, m = 60°; g = 180°; therefore, $m_2 = \frac{1}{3}$; $m_3 = \frac{2}{3}$; s = 120,

and $$k = \frac{360}{180} \cdot \frac{\sqrt{\frac{1}{3} + 2}}{\sqrt{3}} = \frac{2}{3}\sqrt{7} = 1.795.$$

In Fig. 17, m = 180°; g = 180°; therefore, $m_2 = 1$; s = 0.

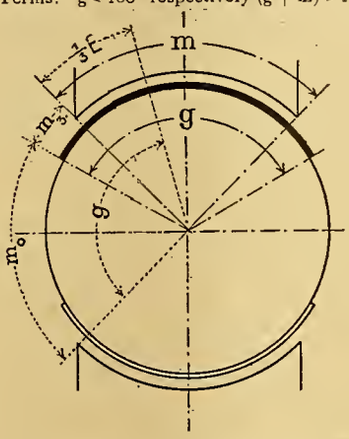
and $$k = \frac{2}{\sqrt{3}} = 1.156.$$

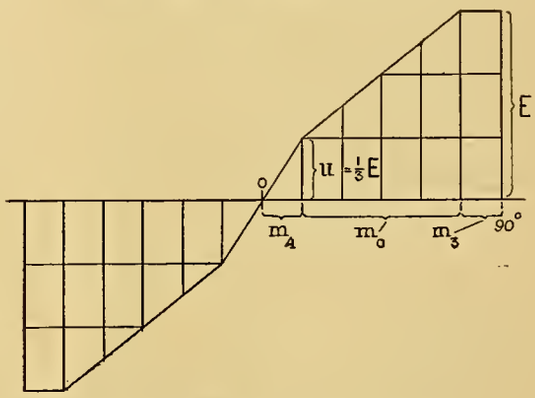
In Fig. 18, m = 180°; g practically = 0; therefore, $m_3 = 1$,

and $$k = 2\frac{\sqrt{3}}{\sqrt{3}} = 2.$$

CASE B.

Terms: g < 180° respectively (g + m) > 180°.





FIGS. 20 AND 21. DETERMINATION OF THE VIRTUAL ELECTROMOTIVE FORCE OF ALTERNATORS.

To find the mean square of Fig. 19, we may use the same method as in case a.

The squares of $C = E^2 m_3$.

The squares of the triangle $B = \frac{1}{3} u^2 m_4$.

The squares of B_0 we can find by integrating between the limits x_0 x_1, and we have squares of

$$B_0 = \int_{x_0}^{x_1} e^2 dx$$

but $$\frac{E}{x_1} = \frac{e}{x}; \quad e^2 = \frac{E^2 x^2}{x_1^2}$$

Therefore the squares of

$$B_0 = \frac{E^2}{x_1^2} \int_{x_0}^{x_1} x^2 dx = \frac{E^2}{x_1^2} \cdot \frac{x_1^3 - x_0^3}{3}$$

We have from Fig. 19:

$$\frac{E}{x_1} = \frac{u}{x_0}; \quad x_0 = x_1 - m_0;$$

Therefore $$x_1 = \frac{E(x_1 - m_0)}{u} = \frac{E m_0}{E - u}$$

and $$x_0 = \frac{E m_0}{E-u} - m_0 = \frac{u m_0}{E-u}$$

Substituting for x_1 and x_0 in the foregoing equation, we have the squares of

$$B_0 = \frac{E^2 \left(\frac{E m_0}{E-u}\right)^3 - \left(\frac{u m_0}{E-u}\right)^3}{3\left(\frac{E m_0}{E-u}\right)^2} = \frac{1}{3} m_0 \frac{(E^3 - u^3)}{E-u}$$

The mean square of all the ordinates of B, B_0 and C is

$$E_1^2 = \frac{\frac{1}{3} u^2 m_4 + \frac{1}{3} m_0 \frac{(E^3 - u^3)}{E-u} + E^2 m_3}{m_3 + m_4 + m_0}$$

but $m_3 + m_4 + m_0 = 1$. Hence

$$E_1 = \sqrt{\frac{1}{3} u^2 m_4 + \frac{1}{3} m_0 \frac{(E^3 - u^3)}{E-u} + E^2 m_3}$$

If we by c denote the ratio of $\frac{u}{E}$ then we may write

$$c = \frac{u}{E} \text{ or } u = cE.$$

Substituting, and using the same treatment as for case a, the coefficient for case b becomes:

$$k = \frac{360}{m+s} \cdot \frac{\sqrt{c\, m_4 + m_0 \left(\frac{1-c^3}{1-c}\right) + 3m_3}}{\sqrt{3}}$$

c, m_3 and m_4 we can easily find by reference to Figs 20 and 21:

$$c = \frac{g + m - 180}{m}$$

$$m_3 = \frac{g-m}{180}$$

$$m_4 = \frac{g + m - 180}{180}$$

and $$m_0 = 1 - (m_3 + m_4)$$

For example (Fig. 20):

m = 90°; g = 120°; therefore, $c = \frac{1}{3}$; $m_3 = \frac{1}{6}$; $m_4 = \frac{1}{6}$, and $m_0 = \frac{2}{3}$;

$$k = \frac{360}{120} \cdot \frac{\sqrt{\frac{1}{3} \times \frac{1}{6} + \frac{2}{3}\left(\frac{1-\left(\frac{1}{3}\right)^3}{1-\frac{1}{3}}\right) + 3 \times \frac{1}{6}}}{\sqrt{3}} = 2.13$$

In some cases it may be of great advantage to let the conductors cover the entire armature surface; it plays an important part in regard to a good regulation of the electromotive force, something that is desired especially for light and power transmission generators. Fig. 22 shows a part of the field and armature of such a generator for two-phase current. The armature is slotted, and has two independent circuits 90° apart; each slot contains one conductor for each phase. It may be of interest to know how wide we have to make the pole-face in order to obtain a curve which is almost a sine curve:

k for a sine curve is: $$\frac{360}{m+s} \cdot \frac{1}{\sqrt{2}}$$

but $m + s = 180°$

and k therefore $$= \sqrt{2} = 1.414.$$

$$m_3 = \frac{180 - m}{180}; \; m_1 = 0; \text{ because } g = 180° \; m_2 + m_3 = 1;$$

$$m_2 = 1 - m_3 = 1 - \left(\frac{180-m}{180}\right) = \frac{m}{180}$$

Substituting in the equation for k (case a), we have

$$k = 2 \cdot \frac{\sqrt{\frac{m}{180} + 3\left(\frac{180-m}{180}\right)}}{\sqrt{3}}$$

By squaring,

$$k^2 = 4 \cdot \frac{(m + 3 \times 180 - 3 \times m)}{3 \times 180}$$

From which we find that

$$m = \frac{12 \times 180 - 3 \times 180 \times 2}{8} = 135°$$

or equal to $\frac{135}{180-135} = 3$ times the degrees between the poles.

In consequence of spreading of lines of force into the armature from the pole-corners, we will reduce the 135° by, say, four per cent., which gives actual width of pole-face to be about 130°. As we in this

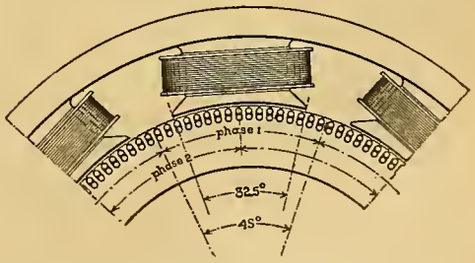


FIG. 22. DETERMINATION OF THE VIRTUAL ELECTROMOTIVE FORCE OF ALTERNATORS.

field have eight poles, or four pairs of poles, the number of degrees a pole incloses is $\frac{130}{4} = 32.5°$.

Up to Date.

Dentist—"Will you have gas, sir?"

Uncle Wayback—"Naw, I won't! Yer thought I'd jump at the chance, bein' brought up with oil lamps, but I fool yer. I've hed gas in th' house fer a year. Gimme 'lectricity!"—New York Evening Journal.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

Suite 510 Marquette Building, CHICAGO.

TELEPHONE, MAIN 1746.

EASTERN OFFICE: 108 TIMES BUILDING, NEW YORK.

Trade Supplied by Western News Co.

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And further this affiant sayeth not.

FRANK FOSTER KENWORTHY.

Subscribed and sworn to before me this 27th day of July, 1897.
Chicago, July 27, 1897. IRA B. JONES, Notary Public.

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To all our friends we extend greetings and assurances of our good wishes. A merry Christmas and a happy and prosperous New Year!

Great preparations are making for the merging of Brooklyn into Greater New York. The Brooklyn aldermen have adopted an ordinance compelling the trolley companies to provide cars for the accommodation of smokers. Not less than one in every three cars must be a smoker between 5 a. m. and 9 a. m. and 5 p. m. and 7 p. m., and during the remainder of the day the average is to be one to five. Now, if the aldermen will compel the companies to provide sleeping cars and "through diners," life in Brooklyn will be made tolerable.

What a change has come over the Bell interests! Nowadays they are ready to celebrate as a victory any temporary check the independent movement may receive, no matter how the result may have been brought about or how great the concession they may have been compelled to make may have been. Thus, we find in the copper country in Michigan that the Bell interests have cut prices and made long-term contracts with the mining companies on the latter's terms. Threatened competition at Houghton has secured a material reduction in the rates of the Michigan Telephone company, according to the admission of that corporation, yet it proclaims a victory over the independent movement.

What has been stated in a general way regarding the influence of the bicycle upon the receipts of street railway companies now appears to be conclusively established by the data compiled under the direction of Major I. B. Brown, chief of the State Bureau of Railways of Pennsylvania, who has made a comprehensive report. Where there are numerous hills and other drawbacks to wheeling the street railway traffic has not been affected, but "in cities like Harrisburg and many others it cannot be gainsaid that the bicycle has become a serious competitor of the railway." This view is supported by the result of observations made on several street railway lines operating under different conditions.

In the rearrangement of powers and duties and responsibilities, not to mention the distribution of offices, under the new order made necessary by the creation of Greater New York, one of the members of the Board of Public Improvements, the chief administrative body of the new municipality, will be the commissioner of public buildings, lighting and supplies, who will succeed to the duties now performed by the superintendent of repairs and supplies and the superintendent of lamps and gas in the Public Works Department. He will also be invested with the functions of the Board of Electrical Control, which will go out of existence with the year. The consolidation has done one good thing at least in killing off the subway commission.

Information is presented in the annual report of the postmaster-general of New Zealand upon the subject of telegraphic service in the colony and the effect of the extension of the lines and the reduction in rates upon the business of the department. Until 1890 the rates prevailing in the colony were one shilling for 10 words, with free address and signature, the charge for deferred telegrams being sixpence. Two years later the maximum number of words was increased to 12 without any alteration of charge. Later another extension of the maximum was granted, and this continued until last June, when the 12-word limit, inclusive of addresses and signature, for sixpence was introduced. At first there was a decided run on the lower charge, the revenue profiting greatly thereby; but in a short time the senders began to cut down messages, so that the average payment, which was nearly 11 pence per message in the first month, fell to a little over nine pence after a 10 months' run. Further shrinkage is expected; while an increase in the number of telegrams is already making an extension of plant and an increased staff of operators necessary. The postmaster-general warns the public that concessions of this magnitude must disturb the revenue very materially and involve a largely increased expenditure for a number of years. The results of this policy should be carefully studied by those considering a similar movement in this country. There is an unreasonable cry for a government telegraph system, the advocates of which hold out as inducements for the support of rural congressmen the promise that the service shall be extended throughout the country districts, and that the tariff shall be lowered The disastrous effect of such a policy in this country can be estimated after consideration of the workings of the plan in New Zealand upon a limited scale.

Royal patronage has ensured the success of the electric cab in London, it is thought, and it may influence a certain class in this country. The London Electrician says: "It is stated that H. R. H. the Prince of Wales patronized the electric cabs in London recently by riding in one of them accompanied by an equerry. This should ensure the popularity of these useful vehicles." Of course, it would be out of the question for any of the "best" people to patronize or even recognize such an innovation until it had secured the approval of H. R. H. Wales.

Strikes are always costly, and when they are protracted they prove a great drain upon the corporations as well as on the employes. The experience in Milwaukee during the late street railway troubles forcibly illustrates this fact. The employes of the company spent the savings they had been years in accumulating, and in many cases found it necessary to go in debt. Much misery and suffering were also produced. Now, the other side is presented to view. The employers, according to court records, spent $123,103 in defeating the men. This fact was brought out by the testimony of an expert accountant, who had examined the books of the company. The lesson is obvious. Arbitration of differences might have saved this annoyance, suffering and expense, if both parties were willing to make some concessions and consider the matter in a spirit of fairness.

Much interest has been shown in the recent decision of the Court of Appeals of New York in the Kingston railroad case, and now that tribunal has denied a motion for reargument. At the same time the court points out that the decision affects only the right of one street railroad company to compel another to allow it to use its tracks under the general railroad act, and does not involve the legality of that use where it has been granted voluntarily. The court rests its decision upon the provision of the railroad act which says that street surface railroads or "extensions or branches thereof" shall not be built, extended or operated unless the consent in writing of a majority of the abutting owners, or that of the municipal authorities, shall have been first obtained. Upon this provision the court decides that without having obtained the consent required, a street railroad company cannot compel another company to grant it the use of its tracks. What a company can do when that use is voluntarily granted, is left for future consideration.

The original decision in this case was handed down several weeks ago, and while the case itself applies only to the city of Kingston, where one street surface railroad sought to use the tracks of another on a street where it was necessary for both to operate to have continuous lines, the decision was general in character, and was held to apply to all other lines in the state. It has been held that the opinion stuck a severe blow to existing street surface roads in New York and Brooklyn, in that it held that one street railroad could not use a portion of the tracks of another road without the consent of the local authorities and adjacent property owners. In Brooklyn especially, the street surface roads have been bargaining with one another to use tracks without regard to the consents of the local authorities and property owners. The Brooklyn roads sought a reargument in order that the court in its subsequent decision might settle definitely many points made in its original opinion, upon which the railroad attorneys placed different constructions.

Although the court denies a motion for reargument in its opinion, it practically holds that the New York and Brooklyn surface roads need not fear any disastrous consequences from the decision and opinion in this individual case. The court says that it was not its intention to decide any case but the one before it, and that the opinion should be read in the light of that purpose.

Sparking, Its Cause and Effect.

[*Continued from page 358.*]

The wearing away of the front edge of the segment is hardly likely to be noticed, since no injury would be looked for until the spark appeared, and then the cutting of the back edge would be much more prominent, because that, being produced by an arc, would have a roughened appearance, while the surface of the front edge would be left smooth by the rubbing off of the melted copper.

Third—The reversal E may be large enough not only to reverse the current in the coil under commutation, but even to increase it beyond the value of half the brush current. In this case the extra current would flow through both segment surfaces, but owing to the fact that this current would be increasing while the receding segment was reducing its contact area, that segment would get hottest, and as soon as it reached the melting point an arc would be drawn and destructive sparking would ensue.

The problem that the designer of the modern machine has before him is to design a machine that will run from no load to 25 per cent. above full load without sparking, and without movement of the brushes.

In the case of machines intended for lighting, the condition of no shifting of the brushes is not generally required, but most of our modern lighting machines are made to fill that requirement.

The current to be reversed therefore varies from the exciting current of the machine up to 25 per cent. above its full load current. The inductance E and the CR drop in the coil also vary in this proportion, and for perfect commutation through all these varying loads it would be necessary for the reversal E also to vary in the same proportion. As a matter of fact, the reversal E does not vary in anything like the same proportion, and may even decrease with increase of load, on account of distortion of the flux coming from the field by the armature ampere-turns.

Perfect commutation for any particular position of the brushes can therefore only take place at one value of the load. At heavier loads than this critical one the current is not completely reversed before the segment leaves the brush and at lighter loads it is more than reversed. This problem may be stated a little more precisely in the following manner:

Assume that the brushes are set as far back as is consistent with sparkless running at the maximum load at which the machine is required to run sparklessly. This means that the reversal E is just equal to the coil impedance E at that point. Now let the load be removed gradually. The impedance E of the coil under commutation is reduced, while the reversal E remains practically constant. The tendency is therefore for the current to be more than reversed, and this tendency increases as the load is reduced, until finally, when the load has been removed entirely, there is no current to reverse, and the reversal E simply tends to produce a current in the coil under commutation. The production of this current is now opposed by the inductance and resistance of the coil, and by the resistance of the brush contact surfaces, the contact surfaces of the two segments being in series as regards this current. If the impedance of the coil is low as compared with this contact resistance, the reversal E would be small compared with the CR drop across the contact surfaces at full load current. Therefore the current produced by the reversal E would be small as compared with the full load current.

We may also note here, that, whereas the variation of the contact resistances aids the reversal of the current, as soon as this current becomes greater than that which flows through the armature, the excess current must pass across the contact areas of both the segments under the brush. The resistances of these two surfaces are then placed in series as regards this current, and the lowest possible resistance that these could have would be reached when the brush covers an equal surface on each segment, making the contact resistance in the path of this current equal to twice the resistance of the contact surface of either segment at that time. The resistance of this path then starts at infinity, decreases to this minimum and goes back to infinity again.

Now examine more closely the order of events in commutation at no load. The resistance of the coil circuit first starts at infinity and rapidly decreases, while the reversal E starts at a minimum and more slowly increases. As soon as a current commences to flow, inductance T enters the problem. If there were no contact resistance, the current would reach its normal full load value at about the middle of the commutation period. This, of course, assumes that the revrsal E is of such magnitude as to reverse the current at full load without the aid of the varying contact resistances. In fact the reversal E does a very small part of the reversing at full load when the inductance is small compared with the contact resistances. The current at the middle of the commutation period would therefore be much smaller than the normal full load current, even if there were no contact resistance to limit it. Now, introducing this contact resistance, which starts at infinity and decreases to a minimum, which may be several times greater than the impedance of the coil, the current must be reduced at least in the proportion of the impedance to this minimum resistance. During the rest of that period the resistance is increasing till at the end it has reached infinity again. The current, already very small, is rapidly cut down till it is too small to produce a visible spark at the break, and the commutator has not been heated up enough at any point to produce arcing.

The same principles hold in the case of machines whose brushes must be shifted, the range of sparkless commutation only being less.

There have been some machines, however, which would not run sparklessly for any position of the brushes. This is readily explained on the hypothesis of too high an impedance, for in that case the variation of the current during commutation will be mainly governed by the impedance and reversal e, instead of by the variation of the contact resistances, so that even if complete reversal is exactly attained, the current density at other parts of the commutation period does not remain constant, with the result that the total energy of commutation is increased. A large part of this energy is concentrated at the beginning and end of the commutation period, thus producing heating at the edges of the segments with its corresponding melting of the copper and arcing.

These considerations indicate two ways by which sparkless commutation may be assured. First, by increasing the brush contact resistance, and second by decreasing the impedance of the coil under commutation.

The limitation of the second of these conditions is merely one of economical design, lowering of the inductance below a certain point increasing the cost of the machine.

The limitation of the first condition is that of rise of temperature of the commutator. It has been shown that for perfect commutation the current density is constant and uniform throughout the whole period of commutation. Its value is found by dividing the total brush current by the contact area of the segments under a brush. This varies inversely with the brush contact area, and the energy developed therefore varies in the same proportion. The amount of commutator metal to be heated, as well as the radiating surface, also varies inversely with the current density, so that the rise of temperature probably varies nearly as the square of the current density, provided the commutation be practically perfect.

The increasing use of the carbon brush in place of the copper brush is thus explained by the fact that the contact resistance of carbon on copper per square inch is much greater than that of copper on copper. Increased resistance is obtained with the copper brush by reducing its contact area, but this also reduces the metal to be heated in the commutator, as well as its radiating surface, so that the same amount of commutating energy will result in a much greater rise of temperature.

By taking these facts into consideration, however, and properly proportioning the contact areas and inductance, commutating machines may be designed to run as cool with copper brushes as with carbon wherever this may be desirable.

The reasoning so far has been based on the assumption of but one coil being commutated at a time. This assumption will only be true when the brush thickness is equal to or less than the width of one segment, plus twice the thickness of the insulation between segments. In practice, brushes are often made to cover a segment and a half, sometimes two segments or even more than this without deleterious sparking. This means that the current in two or more coils is being commutated at the same time.

At first sight, this appears to be an advantage, since it enables us to get the same current density with less length of commutator, but the time of commutation is increased, so that while the rate of development of energy is not changed, the total amount of energy developed will vary with the time of commutation, and, in addition to this, the amount of metal to be heated and the radiating surface are both decreased, so that in this respect the change is rather a disadvantage than an advantage. Another important advantage is gained, however, in that the increase in the length of the commutation period decreases the reactance of the coil by decreasing its frequency of commutation, so that the ratio of impedance to contact resistance is decreased, thus tending toward more perfect commutation. This advantage is again limited by the fact that the mutual inductance of two coils commutating at the same time increases the reaction of both.

To sum up, the deleterious effects of sparking are due to excessive local heating of the commutator contact surface, causing the copper to melt, and an arc to be drawn, the segments being thus disintegrated.

The causes of deleterious sparking are either too great a departure from perfect commutation or too high a current density.

Perfect commutation can only be practically secured by making the impedance of the coil negligible as compared with the contact resistance. A comparison of the sparking constants of a large number of machines was made before this theory of commutation was evolved.

It has been found to explain many cases of sparking, which had before been unexplained.

It has been found difficult to determine definite safe working constants, on account of the small number of tests that have been made to determine accurately the inductance of the coil under commutation and the effect on each other of two or more coils commutating at the same time.

West End Lease Approved.

[From the Boston correspondent of the Western Electrician.]

The Board of Railroad Commissioners of Massachusetts on December 18th promulgated in a special report its decision approving, in a new form, the lease of the West End Street Railway company to the Boston Elevated Railway company.

The lease now proposed contains important changes in several particulars to which attention was called in the special report on the first petition:

(1) The stipulated dividend rental on the West End common stock is reduced from eight to seven per cent. per annum.

(2) The term of the lease is shortened from 99 years to 24 years, eight months and nine days, from October 1, 1897, so that the lease shall expire at the same time with the special immunities which are granted to the Boston Elevated Railway company by St. 1897, c. 500, and which run 25 years from June 10, 1897, the date of the passage of that act.

(3) There is inserted in the amended lease a covenant that the lessee (the Boston Elevated) "shall not diminish the facilities for travel upon the lessor's [the West End] railway as they exist at the inception of this lease, except so far as substantially equal facilities may be furnished in substitution therefor, either by the lessee's elevated railway or otherwise."

(4) The mandatory provision in the former lease, that "the lessor (the West End) shall make and execute such other leases or operating contracts with other street railway companies as the lessee [the Boston Elevated] may request," is now stricken out.

The commissioners review the proceedings and discuss the terms of the lease as follows:

It was stated in the former report that the lease then proposed would have the effect, by virtue of the provisions of section 10 of the statute cited, to exempt the West End system for the period of 25 years from any legislation specifically designed to secure or promote the due and safe transportation of the public on its lines. The same must be said of the present lease. The reason is also the same, namely, that this exemption is not created by the terms of the lease as formulated by the parties, but attaches upon the making of any such lease, whatever its terms, by the force of the statute. While we have not been able to modify our views as to the serious import of the objection involved, we are also confirmed upon further reflection in the opinion before indicated, that this feature of the case is conclusively determined by provisions of law which it is not competent for us to revise. It is the terms of the lease and not of the statute that are subject to the approval of the board.

An objection to the lease not before presented, and not discussed in the previous report, was urged at the recent hearings with much vigor and range of argument by citizens of Boston especially entitled to be heard on the question raised. The objection was stated by ex-Mayor Matthews as follows:

> Our objection, the only objection that we collectively care to impress upon the attention of this board, is that this lease, as now submitted for your consideration, makes no provision for the accommodation along the main line of the subway of the surface cars of the West End Street Railway company; that it will permit the complete diversion for 25 years of the subway from the purposes for which it was voted by the people of Boston, built at their expense and leased by their authority; that it will inevitably result, sooner or later, in the restoration of the surface tracks upon the whole length of Tremont and connecting streets; that the result will be that the main object of the subway will have been lost sight of and destroyed; and that, instead of there being less congestion of traffic in the business part of the city of Boston, there will be an increase of congestion, which will be maintained, without the possibility of relief on the part of the public, for 25 years. That is our main objection, and the only one we care to press.

It was urged in particular that the pending lease would not prevent the apparently intended use exclusively for elevated cars and trains, of the two through subway tracks from Shawmut avenue to Causeway street, which are now designed for surface cars—so that passengers by surface lines, on arriving at the Shawmut avenue entrance to the subway, would be compelled either to change to elevated cars or to reach their destination by circuitous routes; and that it would be impossible during the term of the lease to secure the enlargement of the subway and the building of two additional through tracks, so as to accommodate both kinds of travel, as originally intended and authorized by the subway acts.

The force of the objection evidently turns on the question whether, under the lease, the manner of the utilization of the subway would depend on the will and pleasure of the lessee, as the objection appears to assume, or would continue to be, as it now is, subject to public regulation and control. If by reason of the lease the former condition would arise, the lease ought not to be approved. After careful consideration, both before and since the recent hearings, we have come to the conclusion that the latter condition would continue to exist under the lease.

In the first subway act (St. 1893, c. 478), there is no intimation of the use of the subway in connection with other than surface railways. In the subsequent acts (Sts. 1894, c. 548; 1895, c. 440), provision is made for its use in connection with elevated as well as surface railways. In the latter act, the Boston Transit Commission is empowered to "enter into contracts with any surface or elevated railway company" for locations and other rights in the subway; and under St. 1897, c. 500, the Boston Elevated, upon obtaining a due assignment of the contract made by that commission with the West End, "may operate its railroad in said subway."

All of the rights and obligations with respect to the use of the subway that now exist are created and governed by the provisions of this contract with the West End company. No other subway contract

has been made. The assignment of this contract is authorized in the contract itself; but only on condition that the "succeeding corporation shall assume all the duties, obligations and undertakings herein imposed upon said West End Street Railway company." The statute of 1897 requires that the assignment of the subway contract to the Boston Elevated shall be made "under the provisions of said contract." The pending lease assigns the contract "subject to all the duties, obligations and undertakings thereby imposed;" and any failure by the lessee to comply with the terms of the subway contract works a forfeiture of the lease. We do not find here, either in the statute or in the lease, any evidence of an intention to alter or relax the conditions of the contract; and if such were the intention, there would not be the power. The assignment merely changes one of the parties to the contract. Its terms remain the same. The Boston Elevated would therefore have, under the lease, the same rights, duties and obligations with respect to the subway that the West End now has—no less and no more.

There is no provision in the subway acts by which

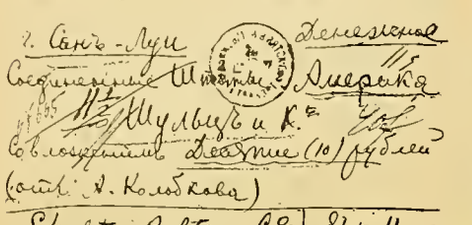


Fig. 1.

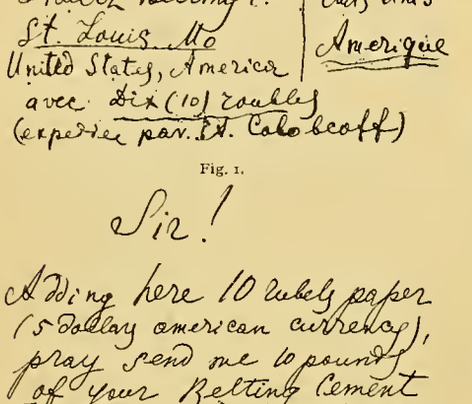


Fig. 2

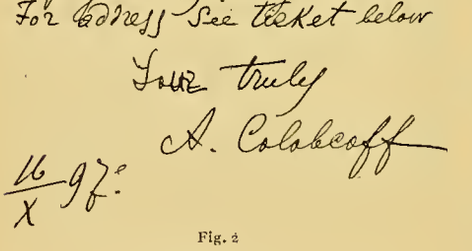


Fig. 3.

RUSSSIAN ORDER FOR AMERICAN PRODUCT.

the corporation holding a subway contract is exempted from the imposition of any burden, duty or obligation by special law; and the contract itself, as stated in the former report, contains an express stipulation that any corporation using the subway shall, with respect to the use and operation of the railway and tracks therein, be subject to all general and special laws that are or may be applicable to such company. By a now existing general law (St. 1891, c. 216), to which the Boston Elevated would be subject, this board, for example, would have the power from time to time to order such additional accommodations to be provided for the traveling public on the subway lines as it should deem that justice to all parties required; and stringent penalties are provided for non-compliance with any such order.

As regards the enlargement of the subway, the Boston Transit Commission, by the subway act of 1895, was given discretion to construct in the first instance any portion of the subway for less than four tracks; but was at the same time authorized to make suitable provision for the future enlargement of any such portion so as to accommodate four tracks; and to construct such enlargement when the commission deemed it expedient to do so. It is moreover stipulated in the subway contract that "the commission, if it deems that public convenience and necessity so require, may make such additions to or improvements or changes in the subway, within the limits defined by existing acts, as it sees fit;" and the party of the second part (the West End) binds itself to equip and use the subway after such additions, improvements and changes have been made, with the same privileges and under the same obligations as before, including the obligation to pay annually 4% per cent. on the additional cost thereby incurred. All of these privileges and obligations, as we have seen, would devolve on the Boston Elevated by the assignment of the contract.

An enlargement of the subway would clearly be an "addition" or "improvement" or "change" in the subway—one, if not all three. An enlargement for four tracks would come "within the limits defined" by the act of 1895, to which the contract appears to refer. Taking the act and the contract together, we have been unable to see any valid ground for a contention that under the lease the transit commission would not have the same power to enlarge the subway that it now has, or that the Boston Elevated would not be under the same obligation to use and pay for the enlargement that now rests upon the West End.

It was suggested that, as the present transit commission expires in 1899, and as no provision is made in the contract for a transfer of its powers in this particular, the right to require the enlargement of the subway would lapse with the commission, and should be provided for in the lease. There would seem, however, to be no question as to the competence of the Legislature to extend the term of the present commisison, or at any time to create a commission with like powers.

It therefore seems clear to the board that the lease would not have the effect to abridge the power of the Legislature or other public authority, by and under general and special laws now or hereafter in force, to regulate and control the manner of the use of the subway, whether for elevated or for surface cars, or for both; or in any way to hinder the enlargement of the subway for four tracks, in pursuance of the provisions of the subway acts and contract above cited.

If, however, these views are not well grounded, what is the remedy proposed? "A few readily drafted clauses," it is said, may be inserted in the lease, binding the lessee company to the conditions in question. If we could see that this method would avail for the further security of the public, we should seriously consider its adoption, even if doubtful as to its need. Who, it must be asked, could compel a compliance with such covenants, if inserted in the lease? Nobody but a party to the lease. The value to the public of a remedy which could be enforced only by one of the parties to this lease as against the other hardly admits of serious discussion.

The trouble, if any, is that the provisions of the subway contract are not sufficiently clear and strong. We did not think a year ago, when these objectors were urging the approval of that contract, and do not think now, that such is the case. If, however, the contract has infirmities that need to be cured, it is idle to attempt to cure them by stipulations in a lease between different parties. It can be done only by some further agreement or assurance by and between the parties to the original contract, or their assigns.

We cannot, therefore, disapprove the lease because it does not contain the provision suggested, for two reasons: First, we do not think their insertion in the lease is necessary; and, second, if inserted in the lease, they would be of no value to the public.[1]

It will hardly be questioned that the alterations in the lease as first submitted have materially improved it in the direction of the public interest. The more important change, in the view of the board, is that which reduces the term of the lease to less than one-quarter of its original length, and thus brings it into harmony with the limited and tentative policy that has otherwise been adopted in dealing with the subject of metropolitan rapid transit.

As regards the proposed dividend rental of seven per cent. on the West End common stock, something should perhaps be added. In consideration of the generally anticipated benefits to be derived by the public from the execution of the elevated railway scheme, to the success of which a lease of the West End system is by many thought essential, the adoption of any extreme view as to a proper rental return would not in the judgment of the board be wise. We are satisfied upon investigation that the impairment of the common stock which was shown in the previous report is not a now accruing impairment. In other words, the property deficit from which the impairment results would have been found larger some years ago than it now appears. If the continuance of present conditions were assured, there is reason to believe that the West End company would be able to repair its capital, to keep good its plant, and at the same time to maintain an average dividend rate of seven per cent. on the common stock. By granting the exemption from reduction of fares and the other immunities that have been referred to, the Legislature has practically given an assurance that the existing conditions shall continue for 25 years. Under these circumstances, it can hardly be said that the agreed dividend rental for the same period is without reason, or that it has not even the implied sanction of law. What would be a reasonable guaranteed dividend rental for 99 years is a different question.

It may be regarded as a matter for some congratulation that the stockholders of the corporations concerned have deemed it expedient, as shown by their recent votes, to make the concessions that have been noted. We are confident that in the long run it will not prove for their disadvantage to have done so. A public-service corporation can acquire no more valuable or remunerative asset than the reasonable satisfaction and good-will of the public it undertakes to serve.

As the case now stands, and in view of the statutory provisions in deference to which our decision must be made, it appears to be the duty of the board to approve the terms of the modified lease, so far as they relate "to the rental or compensation to be paid and to the due and safe transportation of the public."

1. Since the foregoing was written the board has been gratified to learn that the Boston Elevated Railway company has now executed an obligation to the city of Boston, to become operative with the lease, in which that company covenants and agrees that whenever the subway between Scollay square and Shawmut avenue is enlarged or reconstructed for two additional tracks, the company will enter into a contract, to expire with the existing subway contract, for the use and operation of such addition to the subway; and will pay to the city of Boston an annual rental or compensation to be computed on the cost thereof at the same rate, and under conditions otherwise the same, as provided in the present contract. The board is also advised by ex-Mayor Matthews and Col. Thomas L. Livermore, who, acting for themselves and others, appear to have been mainly instrumental in securing this appropriate and effective solution of the question above discussed, that the main objection to the approval of the lease, which, in coöperation with other citizens of Boston, was presented by them at the recent hearings, is now withdrawn.

Russian Order for American Product.

An American manufacturer who receives an order from Russia is naturally expected to have a

FIG. 4, RUSSIAN ORDER FOR AMERICAN PRODUCT.

feeling of pride and satisfaction. This was the experience at least of President J. A. J. Shultz of the Shultz Belting company of St. Louis, who on December 7th was the recipient of a request and a remittance from the land of the czar for four pounds of Shultz belting cement; but Mr. Shultz's pride was somewhat tempered by the fact that the order, which amounted to 10 roubles, an equivalent in Russian money to about $4.70 United States currency, cost him in express charges $2.10. The order came in letter form, and just why the sender should have seen fit to have the money forwarded by express instead of post is not clear, but the fact nevertheless remains that the purchaser evidently was badly in need of the Shultz cement and proposed to have it at whatever cost.

As the form of this Russian order was of a somewhat interesting nature, reproductions of it are presented herewith. Fig. 1 shows the front side of the envelope, with all its curious markings. Fig. 2 shows the peculiar manner in which the Russian started the communication. Fig. 3 shows the address of the gentleman wishing the cement, while Fig. 4 is a half-tone reproduction of the 10-rouble note.

This order is not only an evidence of the high

estimation in which the Shultz products are held, but it is also proof of the wisdom of the company's policy of extensive advertising that has done so much to build up the present magnificent foreign and domestic business of the Shultz Belting company.

Overshiner Telephone Transmitter.

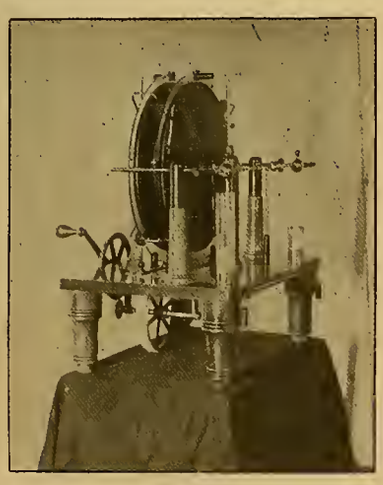
The accompanying cut illustrates a neat and simple "coal grain" microphone transmitter that has just been brought out by the Logansport Telephone Manufacturing company of Logansport, Ind. This instrument is the design of Manager E. B. Overshiner of the Logansport Mutual Telephone company, and embodies what he considers to be the most essential and important principles in a suitable and practical transmitter for the use of independent telephone companies. It is claimed for

OVERSHINER TELEPHONE TRANSMITTER.

this new instrument that it can be placed on any telephone equipment; that it is impossible to pack or get out of order in any way; it is guaranteed to be most sensitive, to have more volume, to be more distinct and take less battery power than any other transmitter. It is further claimed that it will faithfully reproduce the voice without that harsh and metallic sound common to many transmitters. As Mr. Overshiner is in control of the Logansport Mutual Telephone company, its exchange has afforded unexcelled facilities for testing these transmitters. In service in connection with several telephone exchanges and long-distance lines covering over 200 towns and cities in Indiana and Illinois the present form of transmitter is the result of comparison, Mr. Overshiner claims, with the best transmitters in the market. It is claimed that ther are several entirely new features in this instrument, but the manufacturer feels that this transmitter must be seen, examined and tested to be fully appreciated.

New Static Machine.

The static machine shown herewith is made by the Swett & Lewis company, Boston. It is composed of two or more pairs of stationary glass plates be-



NEW STATIC MACHINE.

tween pairs of hard rubber plates. The glass plates are coated by a special insulating and moisture-repelling varnish, and the rubber plates are mounted upon ball bearings especially constructed to run without oil or adjustment. These plates are especially vulcanized and will not warp. The whole machine is mounted in a mahogany case arranged with doors at the ends so that all parts of the whole machine are accessible. It is arranged so that it can be driven by hand or power, at the will of the operator. A spark eight inches long can be obtained in all weather.

The machine shown in the cut is a new one which the company has just gotten out. In it there are four glass plates and four rubber plates. The spark given is the same length as that of the smaller machine but of greater thickness. With this machine the time of exposure is cut down a great deal and much better work can be done than with the smaller machine. Many of these machines are in use in the leading institutions of the country. The larger machine is quite extensively used for therapeutical work. This company makes a special tube for use with static machines.

Life in Washington.

A Washington correspondent declares that the assertion that "Washington is the best governed city in the world" is not entirely in acordance with the facts. There is no gainsaying that the streets of Washington are broad, well paved, well shaded, and generally clean, or that its public parks are models of beautiful breathing spaces, well cared for by the government, but it is contended that if any keen-witted, fair-minded man will examine the matters of street lighting, telephone rates, water supply, gas and electric lighting, and sidewalks, he will admit that the three solons (one a Republican, one a Democrat, and the third an army officer supposedly without any political bias) who, under the direction of Congress, manage the municipal affairs of the District of Columbia, might profitably take lessons from the Common Council of many an insignificant village.

There are only half a dozen streets in Washington and the business thoroughfares which are lighted by electricity, and it is only within the last few months that the commissioners have revoked the ancient order that required the streets to be lighted in any manner only on the nights when, according to the almanac, the moon did not shine. If the almanac happened to be wrong several nights in each month, the citizens were left to grope their way about the streets as best they could in the dark. Another cause of complaint is the fact that a telephone in a private residence in Washington costs $75 a year net, and in a business office, $100, both being in advance.

But bumpy sidewalks, half lighted streets muddy water, unswept snow, unshoveled mud and high telephone charges are as flies on a barndoor to the hardships that the Washington taxpayer suffers at the hands of the company that owns and controls the gas-plant of the city, according to the same authority. The lighting of the streets is bad, but that of the houses is worse. The gas company has things all its own way, and nobody is more keenly aware of that fact than the company. Probably less than two per cent. of the houses in the District of Columbia, including Washington, Georgetown and the many suburbs, are lighted by electricity. This is not because gas is popular and cheap, but rather that electricity is not within reach of the general householder.

Until about a year ago the one electric company had as complete a monopoly in the electrical line as the gas company enjoys. It had not been able to reap such tangible and valuable benefits, however, because of the sensible law that compels it hereafter to lay wires underground. It could not get such authority as it desired for tearing up the streets, and so, as a rule, only the streets in the business part of Washington are lighted by electricity. As to prices, however, and such other conditions as the company could control, it had a "cinch" complete and unquestioned. Then a rival company organized, but when it sought permission to lay wires and to do business it found itself confronted by an opposition in Congress that appeared to be bound hand and foot to the old company.

On getting permission from the District commissioners to lay certain conduits the new company met with the entirely unexpected interference of the Senate committee on appropriations, that sought to put it out of business by assuming the questionable responsibility of stipulating that contracts for lighting should be made only with the old company. Nothing daunted, the new concern commenced the work of laying conduits across the city east and west from Georgetown to Washington. A resolution was introduced into the Senate immediately to stop the work. It was about to pass when David B. Hill came forth as the champion of competition in the interest of the taxpayers. Day by day he fought, by all the tactics of parliamentary skill in which he is a master, to keep the resolution from coming to a vote. In the meantime the work of laying the conduits was conducted day and night. The senator fought until the wires were laid, and won his fight. The new company immediately began supplying light to private consumers, and at once the price of electricity was reduced almost if not quite one-half. But it is still beyond the reach of the average householder, because the small number of conduits makes its transmission too expensive and because comparatively few houses in Washington, except the new ones, are wired for the use of electricity.

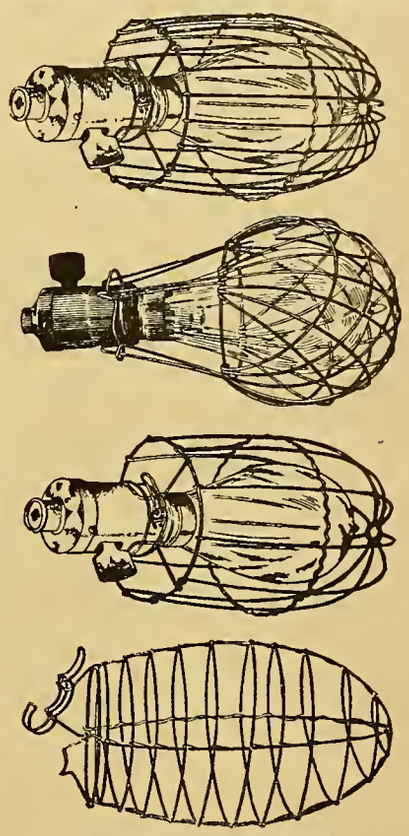
The Telephone in Chinatown.

San Francisco has a novelty in a telephone exchange for the use of the Chinese merchants of Chinatown. Now, Ching Soy Sing, says the Call of that city, is a modest-looking young man, but it is evident that he feels his position, for he says he is the first Chinese telephone "opellata" in the world. The Chinese who have had connections put in their places of business were at first a little nervous concerning the mystery of a voice sailing over a wire and would stand from the 'phone as far as the receiver would permit, but the "unnaturalness" of the system is gradually working off, and seemingly all will be in working order before many days.

Ching's explanation of the workings of the telephone sounded like an act in "The First Born." He said in broken English: "No sabe voice walkee here, but I sabe fixee him for walkee, you bet. One man say, 'Bin ong ke ong sop.' I catchee plug, stab him on board and voicee walkee to me, then to 'nother China boy. One time no catchee 'nother man, I talkee Choy Que Ko. Then 'nother man sit down. He talkee me one time again and I talkee 'Mut ia ho so,' all same Melican man. What man you likee talkee? Next time maybe catchee, then voice walkee. Wat's matter you bet, heap good. I likee sometime, evelybody talkee all samee time. Wat's matta him. I no sabe again. Wha for he do that all timee? If hatchetman talkee, 'bout killee some more men, I hear him and tell 'nother man, you bet I stop him voice walkee, and 'nother man no sabe nothing. I no likee talkee me 'hello gally.' Smart fello sometimee talkee me likee him, 'nother man say 'hello gally' to me. Wha for? No sabe. Next time I stoppe him voice walkee, you bet."

Incandescent Lamp Wire Guards.

The wire guards for incandescent lamps illustrated herewith are manufactured by P. R. Wagor & Co., Springfield, Mass. As will be seen from the illustration, they are made in various styles and adapted to meet almost every requirement. They are made in tinned wire or polished brass and have given satisfaction wherever used. These guards are



INCANDESCENT LAMP WIRE GUARDS.

substantially made, yet the wire used is very thin, so that the light is not obstructed. In addition to the manufacture of wire guards, Wagor & Co. are manufacturers of plain and fancy wirework of all kinds. Further information will be gladly sent by the firm on request.

Electricity in Battleships.

Much interest is displayed by British naval experts in the advances that have been made by American shipbuilders in the utilization of electricity in handling large vessels, especially battleships. Last week the British government received from the Navy Department at Washington a copy of the chief constructor's report of the United States Navy. The Admiralty people say it is deeply interesting to recognize the superior, effective use of electricity for more serious purposes than lighting. They are watching with interest the experiments with electric motors for moving the turrets of battleships, and while they are not enamored of the scheme, they are willing to learn.

Anticipating that Congress will authorize the construction of at least one battleship, the designing bureau of the navy has drawn up preliminary plans for a first-rate vessel of this type, differing somewhat from the ships now being built and intended to have a heavier armament. The new plans call for a ship of not less than 16 knots speed under forced draught, a length of 372 feet by 73 feet beam, and a mean draught of not more than 24 feet on a displacement of 11,500 tons. The plans of the engineers call for twin screws and vertical triple expansion engines, with a maximum indicated horse power of not less than 10,000. The

turrets will be of the deflective type, and an interesting feature of the ship is the more general use of electricity, including the appliance of the power to the turning of the turrets. The plans have been drawn thus early in order that bids may be promptly asked should authority be given by Congress. Heretofore the completion of the new ships has been delayed six months or more, owing to the necessity of drawing entirely new plans.

Electric Traction.[1]

By Cloyd Marshall.

Electric traction is now and has been for some years the foremost branch of electrical industry in the United States, and present indications point to its growing importance. Already there are 13,765 miles of electric lines and the capital invested has reached the great sum of $846,130,000. Nearly every city and village in the country is provided with electric cars, but from now on the development will be in the more important field of heavy traffic. By this term is meant the conditions of service on the elevated and underground roads, the interurban lines and the systems operated under steam road conditions. The elevated service has a very limited application, and only in the largest cities, but on these lines the solution of some of the problems there being worked out will be of material assistance on the surface lines. It has been found that electricity is much more economical and satisfactory than steam in such work. The Metropolitan and Lake Street elevated lines in Chicago and the Liverpool overhead road have demonstrated this point. The equipments are all very similar, except that gearless motors are used at Liverpool.

One notable departure in elevated road practice is the adoption of the Sprague system by the South Side Elevated Railroad company of Chicago, which now uses small steam locomotives in operating its cars. There are a number of new ideas embodied in the apparatus and its arrangement on this system. Each car is equipped as a complete motor car, having a motor on each truck, a controlling mechanism and an air compressor automatically operated by a small motor. The feature which stamps originality on the system is the possibility of joining any number of these cars together, each doing its own part of the work in propelling the train. The controlling mechanism can be governed from any vestibule on the train, and all parts act in synchronism.

The advantages of such an arrangement are apparent. Trains of any length can be run with the motors always working at an economical point, regardless of the number of cars. Cars can be put on or taken off at times of heavy or light service, and at convenient places changes can be quickly made. The power for acceleration, which is so important in elevated road service, is greater with this system than with any other for the weight of each car, and its load is available for tractive effort. These advantages have been secured at the price of complication, and in multiplying the number of pieces of automatic mechanism, while the chances of breakdown and cost of maintenance are increased. The use of small motors will not make a marked difference in the current demand, for the difference in efficiency between a 50 horse power motor and a 200 horse power motor would be little more than two or three per cent. However, the cost of power is not such a great factor on elevated roads as on surface lines.

To test the real merits of the system it will have to be subjected to actual service for a considerable period. Even though it may be more expensive, the flexibility, convenience and higher average speed of the Sprague system might so commend it to the public as to greatly increase the patronage of the road. If it is successful its adoption by the other elevated companies will be only a question of time.

Electric traction is now passing through an evolution, and it is difficult to tell where the limitations will be. The short lines in the cities have been extended into the suburban districts, and connecting roads are being constructed to unite the systems of neighboring towns. The Cleveland suburban and interurban lines are examples of such extension; five lines run from the public square to cities 20 to 38 miles distant. The steam roads are fighting these lines by making nominal rates, but the clean and frequent service of the electric cars more than compensates for everything else.

The apparatus and equipment for electric traction have so far been designed to replace horse power and for the comparatively short lines in the cities. For interurban service, where higher speed and more power are required, the motors have been enlarged, the car bodies strengthened and the double trucks adopted. With plans for the long lines between cities and high speeds in competition with the steam roads, it is evident some more important changes are needed, and the apparatus should be designed to conform with steam road engineering. The conditions of such service are very exacting on the equipment.

The first question is, Can the electric lines compete with the steam roads? It has been the experience near Cleveland, Boston, Hartford and Minneapolis that the trolley roads, parallel to the steam railroads, get the lion's share of the traffic, and this in spite of slower speed. The success lies in the fact that the intervals between the trolley trains are short; the schedule is unvarying; the cars are clean, cool in summer, and warm and well lighted in winter, and stop at convenient points. Most of the interurbans are carrying mail, small packages and express matter, and this affords considerable income. Of course the steam roads do not want the expense of adopting electric traction, but if the business turns to the more convenient, cheaper and popular trolley car, something must be done.

One after another the equipment questions are being solved; there is no longer doubt that the electric motor can perform the work of the locomotive. It can climb steeper grades; the absence of reciprocating parts makes a greater speed possible, and the fact that the source of power is external enables it to have greater capacity and pull heavier loads. The motor does not require skilled labor for handling and repairs, so that the personal factor in the steam engine is much greater than with the motor. Greater acceleration can be attained with the motor; such results as were obtained at Schenectady were never dreamed of with the locomotive. The smoother running of the motor is easier on the track and equipment. One other difficulty with the locomotive is that units of motive power are not available for all kinds of work. Sometimes locomotives are used in passenger service which requires a half, a quarter or a tenth of its power. The steam motor car, recently built at the Schenectady Locomotive Works, is evidence of the fact that such small units are needed in steam road work.

Now as to the coal bill. With the electric line the energy is generated in the most economical manner, while each locomotive is a little generating plant of itself. With express locomotives, operating under favorable conditions, the coal consumption is about four pounds per horse power per hour. One of the New York Central express engines made a record of 3½ pounds. For local traffic five pounds is a good average, and for freight six to 10 pounds is the usual consumption, without considering the coal consumed in starting, banking and drawing the fires. With large stationary engines a horse power hour can be generated with two pounds of coal; some, under very favorable conditions, take but 1.5 pounds. Coal consumed in the power house is very much less expensive in first cost and handling than that on the locomotive. One of the large mills in New England reported the yearly cost per horse power to be $11.64, and the manager of the General Electric company stated in an English paper that the cost per horse power per annum of running a 600 horse power compound condensing engine at the Peel Works was as follows, with coal at $1.68 per ton:

Coal	$4.76
Labor	2.34
Oil and supplies	1.42
Repairs	.12
Total	$8.64

Such figures as these, of course, are not realized in street railway stations, but they show what can be done. The Street Railway Review has been collecting some data on the cost of power house operation, and from the figures I find that the average for 10 of the principal street railways of the United States is .885 cent per kilowatt-hour, or $20.54 horse power for 310 days of 10 hours each, or $43.62 for 365 days of 18 hours. This includes fuel, labor, supplies and repairs, but not interest and depreciation. The fuel bill ranges from 36 to 73 per cent., the average being 54.1 per cent. of the power house operating expenses. As a rule the cost of fuel for an electric system is about five per cent. of the operating expense, while on steam roads it is 10 per cent. Whenever water power can be utilized or the power station located near coal mines or culm heaps in generating power the electric lines then possess very great advantages over the steam roads.

A stud yof the question will reveal the fact that for electric lines the power can be generated and applied more economically than on steam roads; it is the economic transmission of the energy which is the difficult problem. Some writers on electric traction have neglected to fully consider these difficulties and have reached impractical conclusions. As far as an engineer can see into the future it is improbable that electricity will supplant steam for general railroading purposes, but there are some departments of the work where the adoption of electricity will be a great advancement. In thickly settled communities, as parts of the New England, North Atlantic and central states, the railroads will be forced to make changes in their service to successfully compete with the parallel trolley lines. If the example of the New York, New Haven and Hartford Railroad company is followed, this can be done. Service on a private right-of-way enables high-speed service to be given, faster than would be permissible than on the public highways. Col. Heft states that, in consequence of this change, the traffic between Berlin and Hartford has increased 400 per cent. since the opening of the line. It is the old story of better, although costlier, service being more popular and profitable. It is cheaper to travel by canal than on the railroads, but we can hardly consider the canal a competitor of the latter. Although the railroad papers are persistent in decrying the usefulness and adaptability of electricity to steam railroads under any conditions, yet it is significant that they devote much space to the subject, and many of the leading railroad engineers are making a careful study of it. The Illinois Central was instrumental in having the Schenectady acceleration tests made, which were so remarkable in their results. The engineers of the Chicago and Northwestern and the Chicago, Milwaukee and St. Paul were present and admit that they are getting posted on the electric traction. In personal interviews they disclaim any intention of their companies adopting electric traction, yet they say under some conditions it would be advantageous to do so.

It seems the day is near at hand when the electric locomotive will find wide application within the limits of the great cities, and the steam locomotives will be outlawed. At present each railroad track is an unclean strip through the city, and the smoke, soot and dust make contiguous property undesirable. As a result the railroad routes are lined with huts, hovels and tumble-down warehouses. The handsome and costly stations erected by the companies are begrimed and soon rendered unsightly. For public health and the improvement of the city the presence of the locomotive within the city limits should be prohibited. The adoption of the electric locomotive from the limits to the stations would do away with the smoke and filth, and enhance the value of property along the railroad tracks. The railroad men would raise a cry about the dangers of the third rail and the complications at switching points. The same objections, with greater force, have been raised against the use of the trolley in the streets, and the Union Loop and the South Side elevated at its yards in Chicago have succeeded in operating some complicated third-rail work.

For high-speed work the trolley is not suited, the danger limit being about 40 miles an hour, although some experiments have exceeded that figure. One of the large electric companies spent much time and money experimenting on a small Pennsylvania road, and some record tests were made with the trolley. High speed was made for a considerable distance, one mile being covered in 57 seconds, but the trolley wheel jumped the wire, tore down the line and broke off several poles at the ground; also the top of the car was damaged. It is obvious that the trolley will not do for this work, and we must turn to the third rail. Fortunately, the third rail for railroad work costs about half as much as the trolley. It should be protected in some way so that anyone crossing or working on the tracks will not be subjected to danger, and tools and bars will not short-circuit the section by careless handling. Such a system is on the market, though it has hardly passed the experimental stage. Another system which might be worked out would be to have the rail sectioned in lengths of 3,000 feet, more or less as convenient, and energized like the underground magnetic system.

With the present equipment it seems that 500 or 600 volts at most is the limitation of the direct current motor, and long lines can only be operated by placing power stations at frequent intervals, say 10 or 12 miles apart. The transmission at this voltage envolves enormous losses or great expense for copper. On one road recently tested the voltage varied from 525 volts near the station to 240 volts at the end of a line seven miles distant. It is obvious that for transmission alternating currents must be employed. How necessary high voltages are may be seen from a little calculation on the cost of copper for line wire. Mr. Stillwell gives the cost of copper required to deliver one horse power at motor shaft 10 miles from the generator, allowing a 20 per cent. drop and copper 15 cents per pound, at 500 volts, $780.75, and at 10,000 volts, $1.95. Thus it is seen that it costs 400 times as much to furnish copper at 500 volts as it does at 10,000. A voltage of 10,000 is well within present engineering practice.

With apparatus in the present stage of development the best plan is to generate an alternating current at the place of most favorable conditions and transmit at high voltages to sub-stations, where rotary converters will change it to a direct current and supply sections of line of medium length. It is generally believed that alternating current motors are out of consideration for traction purposes, and it is true that the experiments have not been successful on account of the low starting torque and lack of regulation, but the improvements which have of late been made go far in perfecting this machine. As an example of what can be done, reference is made to the 400 horse power two-phase induction motor installed by the Westinghouse company at the station of the Buffalo and Niagara Falls Light and Power company. These machines require practically no attention, having no commutator, collector rings, brushes or any sliding contacts.

The speed of multi-phase motors may be regulated by changing the number of excited poles, the speed being inversely proportional to the number of pairs of poles; also resistance in the armature circuit will have the same effect.

In some recent experiments in Germany, it was reported that a single-phase motor with auxiliary coils of a few turns causing a phase shifting, gave a starting torque 2½ times the normal in the short-circuited armature parallel to the exciting coils. Otherwise the machine was the same as the ordinary single-phase motor and no starting resistance was necessary in the main circuit. Of course this starting torque is not so great as that obtained with the series motor, but the experimenter stated that it could be increased. It is desirable to transmit a single-phase current on one wire and use a phase shifting or splitting device on the car. If

1. Read before the Chicago Electrical association, December 3, 1897.

the third-rail construction be adopted a fourth rail would not be objectionable, as is the second trolley wire, and a polyphase motor can be used. There are many advantages and much economy in the use of alternating currents, and their utilization for railway work depends on the designs of the motors.

The application of electricity to heavy traction promises to be its greatest field, and as the past year has been fruitful in some striking and sucful examples, the coming year will solve many important problems in this line.

Northwestern "L" Extension.

The ordinance extending the time of the Northwestern electric elevated railroad of Chicago may be used by the city officials to increase the compensation paid by that company to the city for its franchise. The joint committees on streets and alleys decided to recommend for passage an ordinance extending the time for the completion of the Northwestern road one year instead of 18 months as asked in the ordinance which was introduced. While the extension ordinance was under consideration Ald. Alling called attention to the fact that it would be a good time to drive a bargain with the elevated railroad for more compensation. It is said that Mayor Harrison and his friends are already considering the feasibility of asking for a better compensation clause.

The Northwestern elevated railroad ordinance was passed during the first meeting of the council over which Mayor Hopkins presided, and in it was inserted what is said to be the first compensation clause in a Chicago franchise. It provides for one per cent. of the gross proceeds for the first 10 years, two per cent. for the next 10 years and three per cent. for the remainder of the life of the franchise. Ald. Alling suggested that it be increased to three, five and seven per cent.

Trains will be running on the Northwestern "L" within six months or a year, according to the present plans of Charles T. Yerkes, if the council approves the recommendation of the joint committees, thus removing the last bar to completing the work. Mr. Yerkes has negotiated a loan sufficient to complete and equip the road.

Work on the incomplete portions of the structure between North avenue and the city's center, it is planned, will be begun as soon after the first of the year as possible. Only the ironwork must be raised, for the foundations are all in except for about half a mile between Chicago and North avenues.

Two miles of ironwork will be necessary to fill in the gap between the loop and the northern portion of the structure. That amount of iron, built expressly for that part of the road, is ready to be shipped at a moment's notice. The right of way is all secured, and no delay would be caused by waiting for the frost to go out in order to set the foundations. In addition to this, the Wells street bridge is rebuilt and ready to receive the tracks of the new elevated line, and the entrance to the loop is laid with track.

In addition to all other preparations for speedy completion and operation of the North Side elevated, the work on the loop power plant is being hurried forward rapidly. For a time, at least, it will furnish not only the power for the loop, but also for the fourth elevated road in Chicago. The plant is being built with much reserve power, and a large part of this, for a time at least, will be used to operate cars on the Northwestern "L."

The Edgewater Improvement association, which embraces the residents of Edgewater and other residents along the lake shore and north of Buena Park, are worried because of the Northwestern Elevated Railroad company's long delay in completing its road. The suburbs are said to be in great need of better transportation facilities, and the people are exceedingly anxious to have the elevated road completed, so as to give them rapid transit to the center of the city.

Petitions of the association and citizens to the City Council will be presented urging that the railroad be speedily completed, and that the ordinance now pending asking for an extension of the time of such completion be promptly passed. The company promises that in case the ordinance is passed it can secure the funds necessary for the completion of its road without further delay. The Northwestern company has spent over $5,000,000 in construction and the balance required is said to be $3,000,000.

Mass meetings have been called in Edgewater, Buena Park, Argyle Park and at Clark and Addison streets in support of the petitions.

Injunction by Telephone.

The telephone is being used frequently in the execution of court orders. At Paterson, N. J., recently the sale of the stock of clothing in the store of Aaron Sonneborn, under a chatel mortgage, was advertised, but creditors of Sonneborn decided to test the legality of the chattel mortgage, and the case was taken into the Court of Chancery. The lawyer hastened to Jersey City and procured a restraining order from Vice-chancellor Pitney. It was five minutes before the time for the sale when the order was signed, and the vice-chancellor called up the deputy sheriff on the telephone and informed him of it, stopping the sale.

Bids for Chicago Street Lighting Plant.

The bids for the arc lighting plant to be erected by the city of Chicago at the Sixty-eighth street pumping station were opened in Controller Waller's office on Wednesday. The figures for the principal types of apparatus are as follows:

Boilers (four water-tube boilers of about 500 horse power each).—Aultman & Taylor Machinery company, Mansfield, O. (Babcock & Wilcox type), $16,824; Heine Safety Boiler company, St. Louis, $19,130.

Engine (Corliss, vertical, cross-compound, belted, condensing, 1,200 horse power).—Filer & Stowell company, Milwaukee, $18,590.

Engines (two high-speed, vertical, compound, 600 horse power, condensing engines, to be direct-connected to countershaft).—Charles F. Elms, Chicago, $12,750; Westinghouse, Church, Kerr & Co., Pittsburg, $13,450.

Engines (10 high-speed, vertical, condensing, cross-compound, 125 horse power engines, to be direct-connected to dynamo shafts).—Charles F. Elms, Chicago, $14,995.

The Western Electric company of Chicago put in a bid for five engines of the Willans type to be arranged to drive 10 dynamos by direct connection, each engine being coupled to a dynamo on each side. This bid, which was $15,000, was rejected for not complying with the specifications.

Dynamos (10 series arc machines of 150 lights capacity each—9.6 amperes at 7,750 volts—arranged for belt driving).—Western Electric company, $20,-500; General Electric company (Brush), $21,800.

Dynamos (10 series arc machines of same capacity arranged for direct connection).—Western Electric company, $28,500; General Electric company (Brush), $30,000.

Wire (246 miles of No. 6 weatherproof line wire).—Central Electric company, Chicago, $17,047.80; Chicago Insulated Wire company, $17,058.13; American Electrical Works, Phillipsdale, R. I., $17,-250.75; Western Electric company, $17,700; Simplex Electrical company, Boston, $18,763.65.

Lamps (single-carbon, all-night, 2,000 nominal candle power).—Charles E. Gregory company, Chicago, $10 a lamp; General Electric company, $19.30 a lamp; Western Electric company, $20 a lamp. About 1,100 lamps will be required.

Hoods and brackets.—General Electric company, $3.25; Western Electric company, $3.50; Charles E. Gregory company, $4.

Controller Waller asked the representatives of the bidders, at the time of the opening of the bids, if company has spent over $5,000,000 in construction, but no objection was recorded.

Charles M. Nicholls, believed to be acting in the interest of the lighting companies on the South Side that will be affected by the construction of the plant, has brought suit as a taxpayer to restrain the awarding of any contracts, on the ground that the appropriation was illegally made by the city government. Until Judge Tuley passes on the application for a preliminary injunction, no action will be taken on the bids by the controller.

CORRESPONDENCE.

New York Notes.

New York, December 21.—The long-expected decision of the Appellate Division of the Supreme Court was handed down on Friday. It is favorable to the tunnel scheme of the Rapid Transit Commission, but embraces one stipulation as to the indemnity bond which causes much concern. The decision was in the nature of an affirmation of the report of the special inquiry commission of the court, but it leaves the matter in such shape that further court proceedings must be had, and no one can tell when a contract for the building of the road will be entered into, if ever.

Four of the five justices concur in the opinion of the court, and there was a dissenting opinion by Justice Ingraham. The opening paragraphs of the prevailing opinion, written by Justice Van Brunt, are as follows:

"The imperious necessity of improved means of transit in the city of New York has long been recognized. It had become so evident that in the year 1893 the people determined that, as there seemed to be no other means for its accomplishment, it should be brought into existence, even by the pledge of the credit of the city. This necessity seems to have addressed itself so strongly to the people that they considered that the accomplishment of this end should be attained, though the ability of the city to carry on contemplated improvements might be thereby curtailed.

"It has been said that the people have not by their vote approved of the plan now presented to the court, but that it was another scheme, which differed in many of its characteristics from the plan now under consideration. I think, however, that a reference to the history of the rapid transit enterprise will show that the people did not give their vote to any particular detail by which rapid transit was to be obtained, but rather in favor of a result to be reached in any manner which might be found to be practicable.

"The presentation of the plan now before the court and the proofs and developments surrounding it constitute striking evidence of the correctness of the conclusions of this court in condemnation of the previous scheme which was submitted to it. This plan, however, calling, as it does, for an expenditure of from $20,000,000 to $40,000,000 less than the scheme presented to the court before, still involves grave questions of law as to the possibility of its completion."

The court then discusses the financial problems involved in the construction of the road, and concludes: "In view of the magnitude of the undertaking which we are asked to approve, and the vital interest which the city has in the prompt completion of the contract for the building of the road when entered into and its effective equipment, maintenance and operation, we think that we should, before consummating our confirmation of the report of the Supreme Court commissioners by the entry of an order to that effect, have some assurance that the powers of the Rapid Transit commissioners in respect to security, provided by section 34 of the Rapid Transit act for the payment of the rental specified in the contract, and for the faithful performance of all the conditions, covenants and requirements provided for in the contract, should be exercised so as to protect the interests of the city in a substantial maner; and to that end a stipulation should be filed by the Rapid Transit commissioners that the penalty of the bond specified in section 34 of the Rapid Transit act will be fixed at not less than $15.000.000. This amount, in view of the large interests of the city involved in its advances of credit for the work as it progresses is not more than sufficient security to the city in the event of the failure of the contractor to perform his or its contract, and to enable it to carry the road to completion in case the enterprise is thrown on its hands by the default or forfeiture of the contractor.

"Upon the filing of the stipulation referred to in the foregoing opinion, an order will be entered upon the usual notice, confirming the report of the Supreme Court commissioners."

Justice Ingraham, dissenting, holds that the report of the commission of inquiry should not be confirmed, because the construction of the road would involve the city in debt beyond the constitutional limitation, and that, therefore, any contract entered into for the purpose would be void.

Comment on the decision relates mostly to the great size of the bond required and as to whether this bond is to cover merely the time of construction or the operation and maintenance of the system during the period of the 50-year lease. At any rate, as neither the advocates nor opponents of the tunnel scheme are satisfied, it is evident that the question is far from a settlement.

It was announced to-day that Ernest H. Crosby had agreed to act as umpire in the dispute between the Electrical Contractors' association and the Electrical Workers' union. There will be no strike after January 1st for the advance of wages demanded, both sides agreeing to be bound by the decision of Mr. Crosby. The first meeting of the arbitration coming Trades Club in the Townsend building, Broadway and Twenty-fifth street.

The business, property and rights of the Electric Carriage and Wagon company, of which Isaac L. Rice was president, and which has been operating since January 1st 14 electric cabs, have been taken over by the Electric Vehicle company. The new company, under the direction of G. Herbert Condict, chief engineer, will electrically operate 100 new hansom cabs and broughams. The premises at 1680-84 Broadway have been leased for the company's principal station. Mr. Rice states that the experience of his company has proved the practicability of the electric vehicle; that it is perfectly safe; that it is attractive to the public, and that the financial results invited an enlargement of the business.

M. S.

Canadian Intelligence.

Ottawa, December 20.—Interest in the cheap electric power question is extending, and the cities and towns between Toronto and Niagara Falls seem prepared to join in a comprehensive project which will give them power from the wires expected to be laid between these points. There are two routes by which Niagara power may be brought to Toronto: The first, and most direct, by cable across the lake; the second, by overhead wire around the end of the lake, and passing Hamilton, Oakville and other places, where power could be largely used. The probable use of electrical energy within the city of Toronto is approximately as follows: For street lighting, 800 electrical horse power; for lighting buildings and private residences, not served by the Edison system, 2,000 horse power; for electric street railways, 3,000 horse power; for incandescent lighting, 2,000 horse power, and for waterworks operations, 3,000 horse power.

The Perth Waterworks company, which is installing the waterworks system for Perth, Ont., will use electric power for pumping. The pump-house is located within the limits of the town, but the power they intend using is about four miles away, on the Tay River. Here it is installing a water-wheel and a 200 horse power generator which will, in addition to that supplying the power for pumping purposes, furnish light and power. The company has bought out the old Tay Electric company, and will distribute light and power on the old circuits. The pumping is to be done by means of a 75 horse power motor belted directly to a triplex double-acting power pump which pumps directly into the mains.

The Cataract Power company of Hamilton, Ont., having had sufficient stock subscribed to complete its plant, has lost no time in getting down to work. A contract has been let for the construction of the canal, which will be about 4½ miles long, from near Allanburgh to the brow of the "Mountain," not far from De Cew's Falls, where a head of 270 feet will be obtained. The water will be taken from the Welland Canal, a short distance above Allanburgh. The distance from the power house to the terminus at Hamilton will be 38 miles. This will be the longest electrical transmission line as yet in actual operation except that of the Blue Lakes Water Power company of California, which transmits power 45 miles. The Cataract Power company will have 4,000 horse power available, and has already closed contracts with a number of corporations and private manufacturing concerns for the supply of power in Hamilton. It is expected that the plant will be in operation by the first of May.

There is a movement on foot at Peterboro, Ont., for the purchase from the Grand Trunk Railway company of the lines of railway extending from that town to Lakefield and Chemong, with a view to their conversion into electric roads.

The Lachine Rapids Hydraulic and Land company of Montreal contemplates supplying the shipping interests of that port with electric power for the purpose of loading and unloading vessels, much cheaper than the same work can be done by steam, besides ridding the harbor front of smoke and noise.

For some time the Hull Electric company has been considering plans for a proposed interprovincial bridge over the Ottawa River between Ottawa and Hull. The plans are prepared, and tenders have been asked for portions of the bridge, which will be of the high-level cantilever type. It will be 50 feet wide, and will have double tracks for railway purposes, two driveways, and two walks for pedestrians. The trestles will be 35 feet high, and the piers will be 150 feet apart.

It is understood that a syndicate of Toronto capitalists has been formed to secure interests in a number of the smaller electric light companies throughout Ontario. The idea is to secure the bulk of the stock in these companies and then amalgamate them under one management. An agent of the syndicate is at present traveling through the province inspecting electric light properties which the syndicate desires to secure.

Toronto electric street railway stock, which has been fluctuating between 70 and 80 for a couple of years, has taken a sudden rise and recently sold at 85.

"The application of the electric current is certainly assuming a wider range every day," said Mr. MacGregor of the Dominion Electrical Heating company of this city to me the other day. "Only a short time ago we were manufacturing electric heaters for a very limited number of purposes, and to-day here is a consignment just about to be sent to a concern in Montreal, the details of which would astonish most people." The consignment in question consisted of a heap of articles that would be tedious to enumerate. Principally among them, however, were tailors' goose irons, hatters' smoothing irons, urns and tea and coffee kettles.

Application has been made to the Ottawa City Council by the Deschenes Electric Light company for permission to do a general light, heat and power business in Ottawa. It has connection with Ottawa through a submarine cable from the Hull side, and is now furnishing power to some special concerns. The company proposes to use underground wires in the resident and business portions of the city.

The directors of the Hamilton, Chedoke and Ancaster Electric Railway company have decided to make an extra effort to dispose of the $15,000 of stock yet unsold of the required $40,000 for the purpose of beginning operations. The directors concluded to send representatives to the conventions of Retail Grocers' and Business Men's associations about to be held, with a view to interesting the members financially in the proposed electric railway.

It is semi-officially announced that the Dominion government will now construct and complete a telegraph line to Dawson City, in the Yukon territory, over the route originally surveyed 30 years ago by George Kennan, the Siberian traveler.

The Packard Electric company of St. Catherines, Ont., has put in an improved sand-blast frosting machine, which will enable it to produce frosted lamps of any style or pattern.

It is reported that the Atlantic and Lake Superior Railway company, which owns the Lachute and St. Andrews railway in the Province of Quebec, intends converting the road into an electric system and extending it to Carillon.

A scheme has been laid before some of the lumbermen in Ottawa by which the sawdust, which has been a nuisance for many years, and the subject of legislation in the Federal Parliament, is to be utilized for the manufacture of calcium carbide, under the process patented by Prof. Wilson of St. Catherines, Ont. By this process the sawdust, slabs, bark and all refuse from sawmills can be rapidly converted into carbon. This carbon is powdered and mixed in equal parts with limestone, and the mixture is then subjected for 10 hours to an intense electrical current, strong enough to convert iron into a boiling mass and lead into an explosive gas. The result is calcium carbide, a substance very much like pig-iron. The mass is broken into small lumps by sledgehammers and in that form is shipped in tin cans to consumers.

The Royal Electric Light company of Montreal, receives every year from that city $160,000. While cities in the United States and Canada pay $50 and $60 a year per arc light, Montreal pays $120, and this condition of things is to last 10 years. The company's profits on incandescent lights are greater, in proportion, than on arc lights.

The noon gun, at Ottawa, is shortly to be fired by electricity direct from Montreal every day. The reason for this is that on account of the complicated and indirect method now in vogue for transmitting the time-signal from the observatory at Montreal to the firing station here, the correct time cannot be ascertained. The plan, now under consideration of the Marine Department, provides for the firing of the gun direct by means of an electric fuse. Instead of the ordinary telegraph battery hitherto employed, it is proposed to utilize the low-voltage current of the city incandescent lighting system. A few minutes before 12, noon, the fuse will be inserted in the loaded gun, and the wires connected at the signal house with the Montreal line. Upon the hour the operator at the Montreal observatory will press an ordinary telegraph key, closing the circuit and instantly discharging the gun. A. V. W.

Washington, D. C.

Washington, December 20.—Senator McMillan has, by request, introduced a bill affecting the overhead wires of the electric lighting companies of the District of Columbia. It is understood that this bill was prepared by the Potomac company, and the last paragraph is said to be aimed especially at the extension of the conduits by the United States company. The Potomac company is fighting the extension in the courts, these having been authorized by the last Congress. The bill allows both lighting companys to lay service conduits to and into alleys of all blocks adjacent to the conduits that may be controlled by such companies. Several provisions are attached to this clause of the bill, the first being that no overhead wires extending over public propcity shall be used in making such connections, and that the burying of overhead wires in the city shall be accomplished within a year. The last paragraph, which is said to be aimed directly at the United States company, reads: "Provided, further, except as herein provided, no public streets, roads, avenues, highways, parks or reservations shall be opened in the District of Columbia for the laying therein of electric light conduits or wires."

The work of installing the trolley conduit system to replace the cable power of the Capital Traction company on the Pennsylvania avenue and Fourteenth street lines is rapidly progressing. All of the conduits for carrying the feed wires from Fifteenth street and New York avenue to the Georgetown terminus, and from the same location to Mount Pleasant, by the way of Fourteenth street, and from the Peace monument to the Navy Yard terminus, are completed. It is not expected, however, that the first car will be run over the route before February 1, 1898. On all portions of the road, except between the capitol and the Treasury Department, the rails will be replaced. The gripmen are being broken in on the electric branch of the road, the Chevy Chase line. T. I. P.

A bill has been introduced in Congress looking to the extension of the tracks of the Capital Traction company in a number of directions. The system to be used will be of the underground electric type now being installed on the lines of this company.

A charter has been granted in Alexandria, Va., to the Washington Electrical and Manufacturing company, with capital stock of $10,000. The president is H. P. Hill of Washington, D. C.

A director of the Moundsville, Benwood and Wheeling electric line, John W. Burchinal, is heading a movement to build an electric line from Frostburg to Piedmont, W. Va., a distance of 18 miles.

The Metropolitan railroad is asking for a right to extend its underground electric system over certain outlying streets of the district not served at present. A. F. T.

PERSONAL.

George M. Chandler, formerly of the Chandler & Taylor company of Indianapolis, is now representing the Brownell & Co. of Dayton, Ohio, builder of engines, boilers, sawmills and sheet-iron works.

E. C. Dunn, local manager for the Western Union Telegraph company at Chattanooga, Tenn., died on December 19th. He was well known in telegraph circles and was said to be the youngest manager employed by the company in the United States.

H. C. Mackey, assistant auditor for the street railway company of Minneapolis, has gone to Milwaukee to assume the duties of his new position as auditor of the Milwaukee Electric Railway and Light company.

Three handsomely executed portraits of well-known street railway men have been distributed among members of the American Street Railway association. They are splendid likenesses of Captain McCulloch of St. Louis, T. C. Penington of Chicago and the late William J. Richardson of Brooklyn.

William Gay, 50 years old, a telegraph operator in the general office of the Western Union Telegraph company at New York, died of heart disease while on a train going from White Plains to New York, December 15th. The body was taken from the train and returned to White Plains in less than an hour after Gay left home to go to his work.

The many friends of A. P. Munning, well known in the electrical business through his connection with the Edison General Electric company, Anaconda Mining company, Central Electric company, Ward Leonard Electric company and the Bullock Electric company, will be interested to know that he has lately accepted the position of secretary and treasurer of the Iron Clad Rheostat company, Westfield, N. J. Mr. Munning's wide acquaintance and experience in the electrical business should make his services invaluable.

The perils attending the establishment of telegraphic communication with many parts of Asia and Africa are brought home by the account just received of the death of E. Graves, assistant superintendent of the Persian Gulf and Persian section of the Indo-European Telegraph department. While inspecting the line between Jask and Chauber, at a distance of 90 miles from the former place, he was attacked in camp and brutally murdered by tribesmen, who entered his tent at dusk, and, pinning him to his bed, mutilated his body in the most frightful manner. The camp was looted and destroyed, but the native staff escaped. Mr. Graves was born December 5, 1844, and had been in the service over 30 years. He was widely known as one of the pioneers of the telegraph in Persia.

ELECTRIC RAILWAYS.

The Lake Street Elevated Railroad company of Chicago has asked the Town Board of Cicero to grant an extension of its franchise for 50 years, in return for which privilege it proposes to extend the road from Fifty-second avenue to Austin avenue, the western limit of Austin, to give a five-cent fare from Cicero to the heart of the city on the main line and 12 rides for $1 on all connecting lines.

The village trustees of New Rochelle, N. Y., have decided to postpone the consideration of electric street railway franchises for a month. This action was taken in order to allow the Union Railway company, the Philadelphia Improvement company and others to compete with the local company for a franchise. The Philadelphia company has offered to pay $10,000 for the right to lay its tracks through the village.

The testimony of an expert accountant who examined the books of the Milwaukee Street Railroad company established the fact that the earnings of the company have been much greater than admitted by the officials. It was said that the books were kept in such a manner that the expense account contained many items which did not properly come under that heading. The expert testified that the cost of operating the road was much less than the books indicated on the surface. It was brought out that the cost of the strike last year was $123,103, and that it was entered under the head of expenses. The salary of Henry C. Payne for the year 1893, he said, was charged to the expense account of 1894.

The street railway lines of Lincoln, Neb., were sold at foreclosure December 17th for $60,500, subject to the lien of the city for taxes to the amount of $60,000. The purchasers were M. L. Scudder of New York and William Belcher of New London, Conn., representing the first and second mortgage bondholders, the New York Security and Trust company and the New York Guaranty and Indemnity company. The first-mortgage bonds amount to $500,000 with five years' defaulted interest and the second-mortgage bonds to $840,000. The two trust companies are not owners of the bonds, but trustees for several hundred owners. The value of the road equipment and franchises was estimated at less than $200,000.

The Indianapolis, Greenwood and Franklin Railway company of Indianapolis, Ind., has selected a new board of directors consisting of George E. Fisher, Detroit, Mich.; John C. Vanatta, Brookston, Ind.; Charles F. Coffin, Indianapolis; James T. Polk and John A. Polk of Greenwood, Ind. Mr. Fisher says that the company will complete the line from Indianapolis to Greenwood, a distance of 10 miles, early this spring, the grading being already completed and the necessary stone arches as well. The power house will be located at Greenwood, to provide the proposed extention to Franklin, a further distance of 10 miles. The power will consist of 700 horse power in water-tube boilers, compound condensing engines and direct-connected generators. The line will be double trolley figure 8; track, 60-pound T-rails; oak hewed ties. Provision will be made for handling freight, the immense canning factory of James T. Polk alone requiring 800 freight cars during the season. Over half the capital stock has been placed, and the company also has a subsidy of $34,000. Five per cent. 20-year bonds will be issued to cover part of the cost of construction. The board will meet in Indianapolis about the middle of January for the pupose of closing contracts for the work contemplated. George E. Fisher, 1113 Majestic building, Detroit, Mich., is chairman of the executive committee, to whom all communications should be addressed.

TELEPHONE.

A new telephone line is being constructed from Warren Point to Raleigh, N. C.

Carolina Beach will be connected with Wilmington, N. C., by telephone in a short time.

H. T. Simpson, superintendent of telegraphs of the Chesapeake and Ohio railway, has completed arrangements with the Bell Telephone company for putting in a private telephone system for the piers and yards in Richmond. The central office will be located in pier 4, where connections may be had with the city system or the long-distance line to Richmond. This step will greatly facilitate the company's Norfolk business.

W. J. Crews of the Bell Telephone company has been in Raleigh, N. C., perfecting arrangements for the extension of the Bell lines into the state. When the line is completed to Danville, through connection will be had to New York and Boston. Mr. Crews states that the Bell company has appropriated $300,000 for the connection of North Carolina towns, and that work will begin at an early date. Raleigh will be the headquarters and all lines will ramify from there.

TELEGRAPH.

The "telegraph trail" is under consideration as an overland route from Spokane to the Klondike. It extends along the abandoned line of the Western Union company, and has frequently been used in all seasons of the year.

Cablegrams are still reckoned among the luxuries. The highest price paid for a single message is said to be $16,000, which was paid for a cablegram sent by Henniker Heaton to Australia in behalf of the British Parliament. Reuter's account of the murderer Deeming's trial, 4,000 words, cost $8,000. An 1,800-word dispatch from London to Argentina cost $7,500. The most expensive private message so far is that sent by the King of Italy to the Duke of Abruzzi, at Rio Janeiro, informing him of the death of his father, the late Duke of Aosta, which cost $2,670.

ELECTRICAL SECURITIES.

The American Bell Telephone company has declared a quarterly dividend of three per cent. and an extra dividend of 1½ per cent., payable January 15th.

The National Railway company of Illinois, which controls the street railways of St. Louis, and the stock of which is largely held in Chicago, has declared the usual quarterly dividend of 1½ per cent., payable January 10th to stockholders of record December 31st.

It is reported that the Central Union Telephone company may resume dividend payments next month at the rate of four per cent. Dividends have been suspended since January, 1895, but the property is now showing increased earnings, and its physical condition is excellent, as extensive improvements have been made.

The Edison Electric Illuminating company of Brooklyn reports gross earnings for November of $86,582, an increase of $5,157 as compared with the same month of last year, and net $43,372, an increase of $1,471. For the 11 months ended November 30th the gross earnings were $795,071, an increase of $50,681 as compared with the corresponding period of last year, and net $361,409, an increase of $28,473.

The Edison Electric Illuminating company of New York reports gross earnings for November of $247,295, an increase of $21,766 as compared with the same month of last year, and net $120,568, an increase of $8,643. For the 11 months ended November 30th the gross earnings were $2,205,630, an increase of $204,468 as compared with the corresponding period of last year, and net $977,822, an increase of $130,646.

MISCELLANEOUS.

Prof. George D. Shepardson of the University of Minnesota has designed a fine Italian marble switchboard for the electrical engineering department, and it will be installed in the chemical and physical laboratory at the university.

The Indianapolis Journal prints a telegram from Muncie, Ind., narrating the result of a storm in that town. It says that during the storm "lightning knocked hundreds of people right and left in this city, but none was seriously hurt." The whole town must have been affected.

Representative Quigg has introduced a bill in the House of Representatives providing for the extension of the letters patent of Baker Jamison and Tallmadge Lambert for an "improvement in insulating submarine cables." The bill was referred to the committee on patents.

The fact has been demonstrated that aluminum is an excellent purifier of water. The salts of this metal are insoluble in water, and, consequently, when these salts are formed the water can be strained and the impurities removed therefrom. Perhaps the most practicable method of purifying water by this means is by employing a trough composed of plates of aluminum and zinc or iron, six or eight inches apart. One end of the tank affords an entrance for the volume of water which passes over the top of one plate and thence under the plate next to it, this being accomplished by the fact that the elevation of the several plates is different. In connection with this tank there is an electrical generator of moderate size. It is explained that when an electric current comes in contact with water in this manner, it decomposes a certain portion of the fluid, and the result of such decomposition is that ozone is formed and oxygen freed—insuring the absolute extinction of life in any microbes or organic matter which the water might contain, leaving it, after meeting the purification the salts of aluminum occasion, as clear and healthful as the water which flows from the purest spring.

TRADE NEWS.

The Manchester Electric company, having completed the extensive enlargements and improvements of its plant, corner of West Brook and Canal streets, Manchester, N. H., opened the establishment for the inspection of the trade on Wednesday, December 22d, at two o'clock.

The Western Electric company has been made exclusive agent for the Tuerk alternating current ceiling fan in the territory west of Pittsburg. It has also been made exclusive agent for the car heaters and office heating devices manufactured by the Globe Heating company.

The Walker company announces that it has recently opened an office at 912 Ellicott Square, Buffalo, for the business in Western New York. The company calls attention to the new alternating generators and power transformers, which it is now prepared to furnish, as well as its direct current apparatus for railway, lighting or power service.

Seth C. Adams has recently been appointed agent for the Walker company, with headquarters at Utica, N. Y., to look after its interests in that vicinity. Mr. Adams is a gentleman well known in the electrical trade, having recently resigned as secretary of the Bossert Electric Manufacturing company of Utica. His favorable acquaintance in the various lines of trade will be of assistance to him in his new location.

Probably the first telephones to be shipped to the Klondike gold mining country were forwarded on a telegraph order by Taber & Mayer of Boston last week. Several wall sets will be used in connection with a tramway service between Dawson City and Dyea. This concern has been doing a large telephone business of late, and reports that its orders have nearly doubled during the last three months, a large portion going West.

Notice is given that the partnership existing between William W. Burnham and James L. Gethins, who have been doing business at 181 Tremont street, Boston, Mass., under the firm name of the Burnham-Gethins company, has been dissolved. Fred A. Fernald has been appointed receiver to close up the business. The settlement of all accounts should be made with the receiver only. Mr. Fernald's address is at 209 Washington street, Boston, Mass.

The India Rubber and Gutta Percha Insulating company, of which William M. Habirshaw is general manager and with which J. W. Godfrey, F. W. Harrington and J. B. Olson are connected, presents its compliments to the trade and announces that the gentlemen named will receive and entertain patrons of the company Friday afternoon, December 31st, 1897, one to six, at room 62, 15 Cortlandt street, New York. The indications for the day are good time and good company.

The new Edison automatic phonograph which has recently been placed on the market, through J. H. Bunnell & Co. of New York, has proved to be a great seller, and far beyond their anticipations. They have now a phonograph which is within reach of the average purchaser, which is equipped with all the latest attachments, and which is claimed to be the best of anything yet produced in this line of work. A new catalogue descriptive of the firm's line of phonographs, records and electrical supplies has recently been issued by J. H. Bunnell & Co.

The American Electrical Works of Providence, R. I., report that they have been astonished at the tremendous increase of business during the last few months. October was the banner month of their business history. President Eugene Phillips has reason to feel proud over the growth of the business of this concern. Through his careful management it has grown from a small business to its now large proportions, and there is no concern that is more widely known for its fair treatment to the trade and its excellence of production. In the large increase in business the West has shown a large proportion of gain.

Friends of S. D. Merton throughout the West and especially in St. Louis are doubtless by this time aware of the fact that he has recently severed his connection with the Heine Safety Boiler company of St. Louis, and has formed the firm of S. D. Merton & Co., contractors. The new institution's attention will be given particularly to making a specialty of boiler settings and other high-class masonry and brickwork in connection with power plants. Mr. Merton, as is well known, has had a most extensive experience in the boiler business, which should be exceedingly valuable to the new concern. S. D. Merton & Co. will have their office at 417 Security building, St. Louis, Mo.

BUSINESS.

The American Stoker company has removed its offices from Dayton, Ohio, to rooms 72-73-74 Garfield building, Brooklyn, N. Y., where all correspondence should be addressed.

"It is more blessed to give than to receive;" therefore, the American Electrical Works points out that a golden opportunity is offered its friends at this season to attain perfection by giving the Providence concern orders for railway feeder and trolley wire, telephone and telegraph wire, cables, etc. Its Chirstmas tree is a creation of great artistic value.

McKinlock & Camp, agents of the successors of the Metropolitan Electric company, are handling the new standard dry battery which is manufactured by William Roche, the pioneer dry battery maker. It is claimed to be superior to any dry battery on the market, and a sample test will, it is said, verify this statement. The new address is 175 Randolph street, Chicago.

The "Two Balls" adjustable incandescent lamp hangers, manufactured by M. I. Vought, 202 South Front street, La Crosse, Wis., are considered to have such merit that they are sent on approval. "If not satisfactory, return them," says Mr. Vought. The device is said to be very efficient and extremely simple. It has been on the market but a few months, but large sales are reported, including shipments to Europe, Canada, Mexico and Australia.

New time-tables just adopted on the Pennsylvania Short Lines between Chicago and Cincinnati and Louisville, and between those gateways and winter havens in Florida and the South, present unusual facilities for a quick and comfortable trip. The route is the most direct, the train service is fine, the tourist rates are reasonable. H. R. Dering, assistant general passenger agent, 248 South Clark street, Chicago, will answer inquiries on the subject.

The Highland electrical soldering paste is rapidly coming to the front as the only soldering flux to use where careful work is a requisite. It is claimed that careful comparative tests have shown that this paste gives the best joint that can be made with the least possible amount of solder and without any corrosion whatever. It is now being used almost exclusively by telephone companies, where the foregoing points of merit are particularly valuable. The electric light companies are also coming to realize that it is very important that every joint made on their lines should be a good joint, and are now using the Highland paste extensively. The Electric Appliance company, Chicago, is sending out a two-ounce box, which gives a good opportunity to test the paste. This is a supply of paste which will last probably as long as one pound of soldering salt.

The catalogue of Edison incandescent lamps recently issued by the General Electric company forms the most complete document of the kind ever produced. It is really a treatise on incandescent lamps from the customer's viewpoint. The catalogue begins with introductory chapters on the "Production, Selection and Use of Lamps," in which are set forth in a concise, telling manner the methods employed in the manufacture of this lamp, and some idea of the importance and value of skill and experience in lamp production, how to select the type best suited to the purchaser's conditions, and the necessary requirements for the proper use of lamps. Descriptions of several types of lamps follow, and a full-sized illustration accompanies each lamp described. The descriptions and illustrations include every class of lamp manufactured by the General Electric company, of which there are over 30,000 varieties, including the various voltages and candle powers, etc., and of which the General Electric company produces and sells annually over 6,500,000. An "Appendix of Information on Incandescent Lamps," of great value to all lamp users, is another feature. The opening discussion is on the "Life and Candle Power of Lamps," in which the subject of decline of candle power and its bearing upon the lamp renewals is clearly set forth. Next is a chapter on the "Importance of Good Regulation," and additional chapters on the "Method of Measuring Lamp Value by Candle Power Area," "Special Points to Be Remembered in the Use of Lamps," "Faults in Incandescent Lamps" and tables of lamp data. The concluding chapters of the appendix are given to the subject of "General Illumination and Correct Use Light," and "How to Avoid Harmful Effects on the Eyes." Altogether the catalogue is complete and interesting; its typography is excellent and the illustrations of the lamps well designed and executed, making it a valuable and useful book of information and reference. Copies have been sent to station managers throughout the United States and can be obtained from the General Electric company's lamp works, Harrison, N. J., or at the nearest local office.

ILLUSTRATED ELECTRICAL PATENT RECORD.

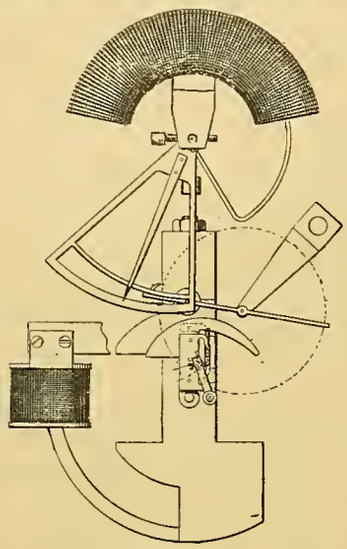
Issued December 14, 1897.

595,293 Electric Railway. John R. Farmer, St. Louis, Mo. Application filed March 2, 1896.

This system employs surface contacts, and a bridging-shoe is carried by the car having means for rendering it magnetic to operate a circuit-closer in the road-bed; the contact device has a magnetic contact exposed on the surface and a projecting horn also of magnetic material extending in the direction from which the car approaches, whereby a preliminary effect is produced on the circuit-closer.

595,294. Railway Signal. William J. Fawcett, Pittsburg, Pa. Application filed February 4, 1897.

A bracket is mounted on the car; the solenoid magnet is supported thereon, and the vertically movable spiral armature bar is designed to work within the magnet; a slotted bracket arm through which the spiral portion of the armature bar reciprocates to cause a rotary movement thereto; a signal-board mounted on the bar and a spring to return the latter to its normal position are also provided.



NO. 595,325.

595,325. Electric Meter. William D. Marks, Philadelphia, Pa. Application filed September 10, 1897.

There is an oscillating electric motor or pendulum, with a circuit controller for periodically opening and closing the circuit, comprising a contact plate movable with the pendulum, a second contact carried by an overbalanced arm pivoted to a stationary support eccentrically to the pendulum and capable of movement independently of the pendulum to periodically open and close the circuit, an insulating guard for limiting the movement of the pivoted contact, and a device co-operating with the circuit controller for maintaining the regularity and proper duration of contact at the circuit controller.

595,327. Electrical Lighter for Burners. Svend M. Meyer, Brooklyn, N. Y. Application filed November 6, 1896.

Essential features of the combination are the case batteries and conductors, with the metallic lamp-cone and the resistance coil in the circuit, which is closed by the application of the lighter to the lamp burner.

595,329. Means for Generating Electricity from Car Wheel Axles. Morris Moskowitz, Newark, N. J. Application filed May 17, 1897.

A dynamo-electric machine, subject to variable armature speed, has a self-excited field coil in shunt with its armature, an opposing high resistance coil, a series coil wound in the opposite direction around the field of the dynamo, and an automatic regulating device comprising a series coil and a make-and-break device connected therewith for regulating the flow of electricity through the coils on the field of the dynamo, consisting essentially of a plunger connected with a pair of pivoted arms normally acting against a tension spring, and contact arms connected with the plunger and movable against certain contacts connected in circuit with a coil on the dynamo field.

595,330. Electric Regulator. Morris Moskowitz, Newark, N. J. Application filed May 26, 1897.

The device comprises in combination with a coil a movable plunger in the coil, a frame connected with the ends of the plunger, a pair of contact arms connected with the frame, contact posts between which the arms are adapted to vibrate, and mechanical means connected with the frame to cause contact between the arms and the contact posts when there is no current of electricity passing through the coil.

595,338. Insulated Joint for Gas Fixtures. Joseph W. Parkin, Philadelphia, Pa. Application filed January 11, 1897.

In a joint for gas fixtures members are provided with flanges, and sleeves hold the members in juxtaposition, one of the sleeves fitting within the other, whereby the sleeves are held in position, an insulating ring intermediate the flanges, insulating rings adjacent the flanges, metal rings intermediate the sleeves and rings, and offsets located opposite each other and forming locking devices.

595,343. Blind Raised or Lowered by Means of Electricity and Solar Rays. Eugen Roth, Osnabrück, Germany. Application filed December 5, 1896.

A motor is employed to operate the shade roller, and is controlled by the sunshine-operated circuit-closer, comprising the U-shaped tube containing a circuit-closing fluid, the three switch plates, the circuit wires extending from the switch plates to the circuit-closer and adapted to form two circuits, the switch having electrical connection with the motor, and having two arms adapted to contact with two of the switch plates, and means for automatically shifting the switch at the limit of the movement of the shade roller in either direction to reverse the polarity of the armature and field with relation to each other.

595,344. Controlling Device for Electric Motors. Frank J. Russell, New York, N. Y. Application filed April 22, 1897.

The method of controlling an electric motor consists in establishing in an electro-magnetic circuit-closing device a succession of current impulses corresponding in direction to the deviation of the controlling lever, and thereby causing the armature of the motor controlled by the device to move in a direction corresponding to the direction of the current impulses, and to an extent depending upon the number of current impulses.

595,345. Electrical Controlling Mechanism. Frank J. Russell, New York, N. Y. Application filed May 7, 1897.

Two fixed contact plates and a movable contact plate are employed, the faces of which are inclined and substantially parallel, and a body of insulating material on one face of the movable plate.

595,364. Space Block for Armature Cores. Asa F. Batchelder, Schenectady, N. Y. Application filed September 15, 1897.

A space-block for armature cores, consisting of an internal support or spider, a circumferential ring mounted on the arms of the spider, and radial arms consisting of thin strips of metal mounted on the circumferential ring.

595,375. Electric Signaling Apparatus. William E. Decrow, Boston, Mass. Application filed July 17, 1897.

A signal-box having means for transmitting two classes of signals, one of which is accompanied by a differentiating impulse, a message-recording instrument for receiving the signals of both classes, and a bell constructed and arranged to respond successively to the impulses of one class of signals, and to respond continuously upon the reception of a signal of the other class.

595,395. Rheostat or Electric Heater. Frank Kraemer, Chicago, Ill. Application filed January 23, 1896.

Solid carbon sticks of a high resistance are completely embedded in a plastic material composed of barite or its equivalent and silicic acid.

595,398. Electric Alarm Device. Fedor Louis, Brooklyn, N. Y. Application filed January 7, 1897.

The steam pipe is provided with a downwardly directed loop or bend, in the bottom of which is placed mercury, the upwardly directed arm of the loop or bend being provided with a float which is suspended therein by a cord or other device which is passed over pulleys, and the opposite end of which is provided with a weight which moves in a vertical guide or casing, and other devices are adapted to be operated by the weight for closing an open circuit in which the electrical alarm device and the battery are placed, and a clock is supported adjacent to the device and is adapted to be stopped thereby.

595,402. Conductor for Electrical Apparatus. John Mills, U. S. Army. Application filed March 27, 1897

An electric conductor made of thin strips or laminations of material is both a conductor of electricity and also capable of being affected by and of readily transmitting magnetic force or influence, and having the laminæ separated by insulating material.

595,403. Transformer. Walter S. Moody, Lynn, Mass. Application filed February 10, 1897.

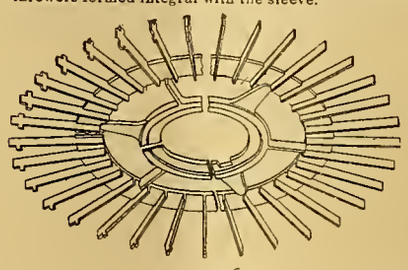
There is the combination of a core, a winding mounted thereon, and a winding in inductive relation to the first-named winding and connected to a three-wire circuit comprising a plurality of coils connected to each side of the three-wire circuit, the coils being so arranged on the core that they receive substantially equal induction from the first-mentioned winding under balanced and unbalanced loads.

595,409. Electric Railway Motor. Edward D. Priest, Schenectady, N. Y. Application filed February 23, 1897.

The combination is described of a field magnet, an armature, a shaft therefor, brasses mounted above and below the shaft and partially encircling it, supports and guides for the brasses, means for adjusting the brasses, chambers on both sides of the shaft, and waste in the chambers engaging with the sides of the shaft.

595,410. Electric Motor. Edward D. Priest, Schenectady, N. Y. Application filed April 13, 1897.

Claim is made in an armature for the combination of a body of laminæ, a sleeve to which the laminæ are secured, a shaft rotating with the sleeve, and an oil thrower or throwers formed integral with the sleeve.



NO. 595,364.

595,412. Regulating Alternating Current Dynamo-electric Machines. Edwin W. Rice, Jr., Schenectady, N. Y. Application filed October 26, 1894.

The method of regulating an alternating current dynamo-electric machine consists in causing the main current to strengthen the exciting current with an increase of lag, and to weaken it with an increase of lead.

595,413. Braking Alternating Current Induction Motors. Edwin W. Rice, Jr., Schenectady, N. Y. Application filed March 6, 1897.

The method of braking the load connected to an induction motor consists in connecting the motor with a circuit capable of absorbing energy, and passing through its inducing member an alternating magnetizing current of a frequency such that the motor will act as an induction generator.

595,419. Method of and Apparatus for Converting Electric Currents. Elihu Thomson, Swampscott, Mass. Application filed February 27, 1897.

The art of converting electric energy described consists in energizing a coil at relatively high potential, breaking the circuit of the coil and at about the same time closing the circuit of a low potential coil in inductive relation thereto, and then interrupting the current flow in the second coil, thereby setting up in another coil the desired electromotive forces.

595,420. Electric Arc Lamp. Elihu Thomson, Swampscott, and Charles E. Harthan, Lynn, Mass. Application filed June 12, 1897.

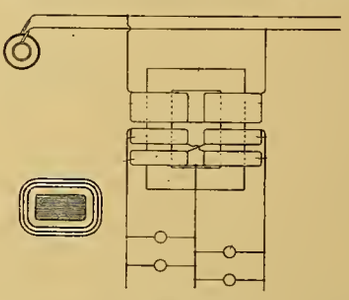
A central vertically movable tube for carrying the upper carbon, a pair of dash-pots yoked to the tube, and pistons for the dash-pots, mounted on the main frame, are set forth.

595,446. Prepayment Attachment for Electric Meters. John Strachan and James Niven, Saginaw, Mich. Application filed May 11, 1897.

Provision is made for a fixed coin chute, a pivoted coin chute, a lever projecting into the pivoted coin chute in the path of the coin, a train of spring actuated gearing carrying a rotating switch-bar forming part of the lighting circuit and controlled by a pawl operated by a solenoid, and means for energizing the solenoid by the action of the coin-actuated lever.

595,570. Controlling Device for Electric Railways. Rudolph M. Hunter, Philadelphia, Pa. Application filed October 12, 1897.

A controller device for electric motors consists of a counter-electromotive force generator, a series of resistances and a hand-switch device for alternately varying the counter-electromotive force of the generator and inserting resistances and successively removing the resistances while maintaining the counter-electromotive force.



NO. 595,403.

595,573. Galvano-cautery Instrument. Charles MacGregor, Dayton, Ohio. Application filed October 16, 1897.

The handle consists of two parts of non-conducting material, each having angular cavities and longitudinal grooves in their meeting sides; electrodes are adapted to fit into the grooves, and angular contact blocks to which the inner ends of the disconnected electrodes are affixed, the blocks being loosely inclosed in the cavities in the handle and prevented from becoming detached from the ends of the electrode.

595,575. Electric Signal Indicator. Maunsell Mercier, Manchester, England. Application filed March 3, 1897.

A rotary indicator is mounted on an arbor or spindle and has a ratchet-wheel on the arbor, the indicator being normally actuated in a backward direction. There are also an electro-magnet having an armature, a pawl connected with the armature and adapted to engage the ratchet-wheel to actuate the indicator in a forward direction, a dash-pot and a close-fitting piston therein, an arm connected with the armature and adapted to raise the piston, a detent adapted to engage the ratchet-wheel and engaged by the piston, and a secondary electro-magnet having an armature adapted to engage a valve in the dash-pot.

595,580. Secondary Battery. Paul F. Ribbe, Berlin, Germany. Application filed April 7, 1896. Patented in Norway March 16, 1896; in Spain May 22, 1896; in Hungary October 30, 1896; in Denmark February 10, 1897; in Sweden April 8, 1897, and in Canada July 15, 1897.

A celluloid plate is placed on each side of a lead plate having apertures. The celluloid plates have projections extending into the apertures in the lead plate and thereby forming contact, at which contacts they are united, and active material is held on the lead plate by the celluloid plates.

595,584. Incandescent Lamp Socket. Duny A. Schutt, Peru, Ind. Application filed April 16, 1897.

A three-part socket is composed of insulating material comprising a securing base, a lamp-receiving socket, a rigid metallic intervening connecting post provided with means for attachment of a lamp within the socket comprising a normally closed terminal, and a terminal mounted in the socket designed to contact with the base of a lamp, with an intervening movable shifting ring provided with binding attachments for circuit wires, and contact springs for transmitting the current to the terminals.

595,585. Fuse Block. Duny A. Schutt, Peru, Ind. Application filed April 16, 1897.

A fuse block consisting of a circular dome-shaped hollow body of insulating material is provided with a securing bracket, internal annular pin-retaining flanges integral therewith on the opposite inside faces thereof with intervening openings, an annular space above the flanges with oppositely located contact springs therein midway of the flanges connected to binding posts mounted on the outer face of the flanges.

595,590. Electric Railway System. Merle J. Wightman, Scranton, Pa. Application filed August 10, 1896.

A conduit with a continuous flexible conductor which is adapted to be lifted by magnetic attraction and rigidly secured at one end by a suitable clamp and at the other end wound about a weighted roller.

595,659. Trolley Stand. Sidney H. Short, Cleveland, Ohio. Application filed September 26, 1896.

In a trolley stand, the combination of a base, a trolley-arm support mounted on a vertical axis upon the base, and a trolley arm pivoted on a horizontal pivot to the support, with the rod secured to the support, the collar which slides upon the rod, the links and the two springs which embrace the rod.

595,660. Pipe Organ. Ernest M. Skinner, Boston, Mass. Application filed February 21, 1896.

Provision is made for electro-magnets having a plurality of independent windings, an independent energizing circuit for each winding, including a key contact and an intermediate switch-plate or switch, a return wire common to all the independent energizing circuits, and a suitable source of electric energy.

Western Electrician

$3 per Annum. Copyright, 1897, by Electrician Publishing Company, Chicago. EVERY SATURDAY. Entered at Chicago Postoffice as mail matter of the second class. 10 cents per Copy.

Vol. XXI. CHICAGO, JULY 3, 1897. No. 1

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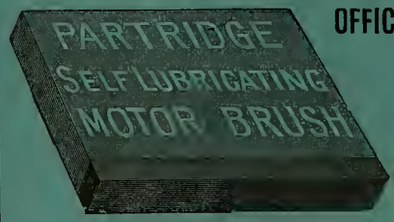

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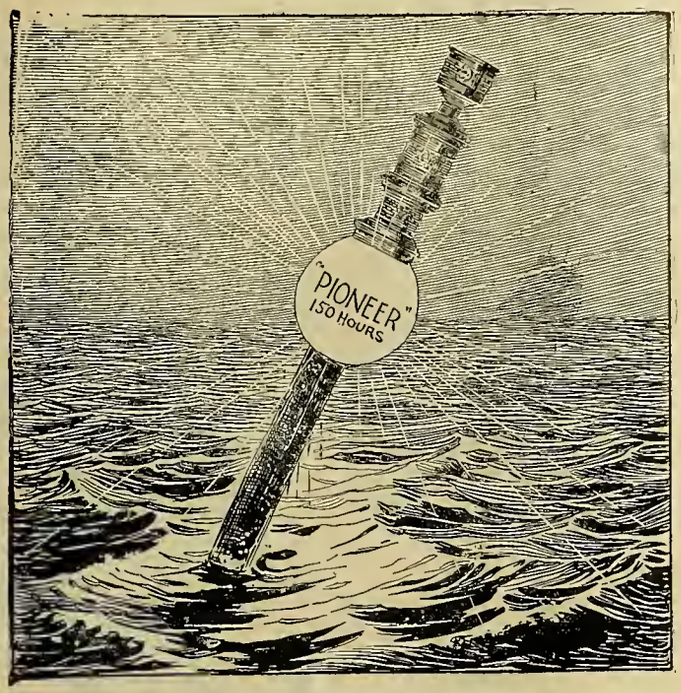

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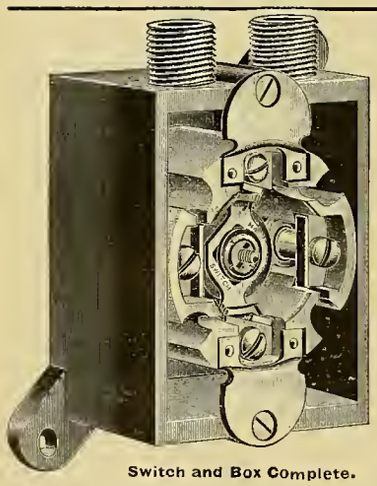

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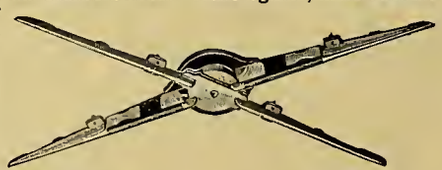

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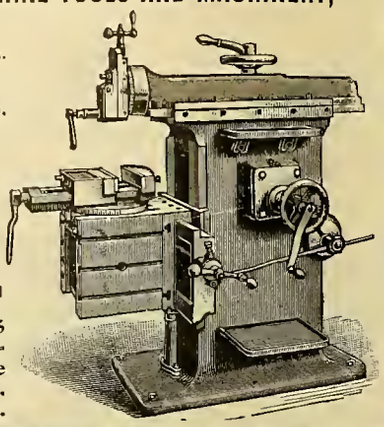

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Besly & Co., Chas. H.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
Genor & Colburn.
Hodge, Walsh & Loring.
International Elec. Co.
Metropolitan Electric Co
Ohio Electric Works.
Paiste Co., H. T.
Partrick & Carter Co.
Peoples Electric Co.
Peru Elec. Mfg. Co.

Globes and Electrical Glassware.
Central Electric Co.
Commercial El. Supply Co.

Gov'nors, Water Wheel.
Lombard Water Wheel Gv. Co.

Graphite Specialties.
Besly & Co., Chas. H.
Central Electric Co.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Induction Coils.
Central Electric Co.
International Elec. Co.
Queen & Co.

Insulators and Insulating Materials.
Brixey, W. R.
Bryant Electric Co.
California Asphalt Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
Empire China Works.
Hodge, Walsh & Loring.
Johns Mfg. Co., H. W.
Mica Insulator Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Paiste Co., H. T.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Phillips Insulated Wire Co.
Standard Paint Co.
Simplex Electrical Co.
Standard Underground C. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

Lamps, Incandescent.
Buckeye Electric Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
General Electric Co.,
Lynn Incandescent Lp. Co.
Metropolitan Electric Co.
Ohio Electric Works.
Perkins Elec. Switch Mfg. Co.
Sawyer-Man Elec. Co.
Western Electric Co
Westinghouse El. & Mfg. Co.

Lamp Trim'r's Wagons.
Studebaker Bros. Mfg. Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Westinghouse El. & Mfg. Co.

Magnet Wire.
(See Insulated Wires.)

Mechanical Machinery.
Besly & Co., Chas. H.
Garvin Machine Co., The.
Stilwell-Bierce Smith-Vaile

Mica.
Central Electric Co.
Commercial El. Supply Co.
McLaurin & McLaren.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
General Electric Co.
Westinghouse El. & Mfg. Co.

Motors.
Ahlm-Edwards Elec. Co.
American Engine Co.
Belknap Motor Co.
Brush Electric Co.
Bullock Elec. Mfg. Co.
Card Electric Co.
Central Electric Co.
Chicago Armature Co.
Commercial El. Supply Co.
Dallett & Co., Thos. H.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Metropolitan Electric Co.
Muir & Son, Thos.
Northern Electl. Mfg. Co.
Ohio Electric Works.
Peoples Electric Co.
Scott & Janney El. & Mfg. Co.
Stanley Elec. Mfg. Co.
Storey Motor & Tool Co.
Triumph Electric Co.
Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co

Packing.
Besly & Co. Chas. H.
Garlock Packing Co.
Johns, H. W., Mfg. Co.
Peerless Rubber Mfg. Co.

Paints.
California Asphalt Co.
Central Electric Co.
Commercial El. Supply Co.
Johns, H. W. Mfg. Co.
Standard Paint Co.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co. Ltd.

Platinum.
Baker & Co.

Poles.
Carley, Ira.
Lindsley Bros.
National Tube Works Co.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Sterling & Son, W. C.
Valentine-Clark & Co.

Porcelain.
Bryant Electric Co.
Central Electric Co.
Commercial El. Supply Co.
Empire China Works.
Peru Elec. Mfg. Co.

Push Buttons.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Partrick & Carter Co.

Refiners.
Swarts Metal Refining Co.

Reflectors.
Muir & Son, Thos.

Regulators.
Belknap Motor Co.

Re-Winding.
Central Electric Co.
Chicago Armature Co.
Chicago Edison Co.
Electrical Exchange, The.
Hodge, Walsh & Loring.
National Electric Co.

Rheostats.
Am. El. Heat. Corporation.
Central Electric Co.
General Electric Co.
Iron Clad Rheostat Co.
Leonard, Ward, Elec. Co.
Muir & Son, Thos.
Westinghouse El. & Mfg Co

Second-Hand Machin'y.
Chicago Armature Co.
Cornman Co.
Electrical Exchange, The.
National Electric Co.

Shades.
Central Electric Co.
Muir & Son, Thos.

Speaking Tubes.
Central Electric Co.
Electric Appliance Co.
Partrick & Carter Co.

Speed Indicators.
Besly & Co., Chas. H.
Central Electric Co.
Keystone El. Instrument Co.
Queen & Co.
Weston Electrical Inst. Co.

Steel Pipe.
National Tube Works Co.

Storage Batteries.
American Battery Co.
Central Electric Co.
Electric Storage Battery Co.
Ohio Storage Battery Co.
Willard El. & Battery Co.

Tapes, Insulating.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co
Okonite Co., The.
Simplex Electrical Co.
Standard Paint Co.
Washburn & Moen Mfg. Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Commercial El. Supply Co.
Farr Tel. & Cons. Sup. Co.
Kusel, D. A., Tel. Mfg. Co.
Lockwood T. & T. Co. of Am.
Metropolitan Electric Co.
Orne Elec. Cons. Co.
Peoples Electric Co.
Standard Tel. & El. Co.
Stromberg-Carlson Tl. M. Co.
Taber & Mayer.
Viaduct Mfg. Co.
Western Tel. Cons. Co.
Whitman & Couch.

Transformers.
Central Electric Co.
Commercial El. Supply Co.
Diamond Elec. Co.
Ft. Wayne Elec. Corporation
General Electric Co.
Stanley Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

Trolley Cord.
Central Electric Co.
Samson Cordage Wks.

Trucks, Electric Car.
Brill Co., J. G.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

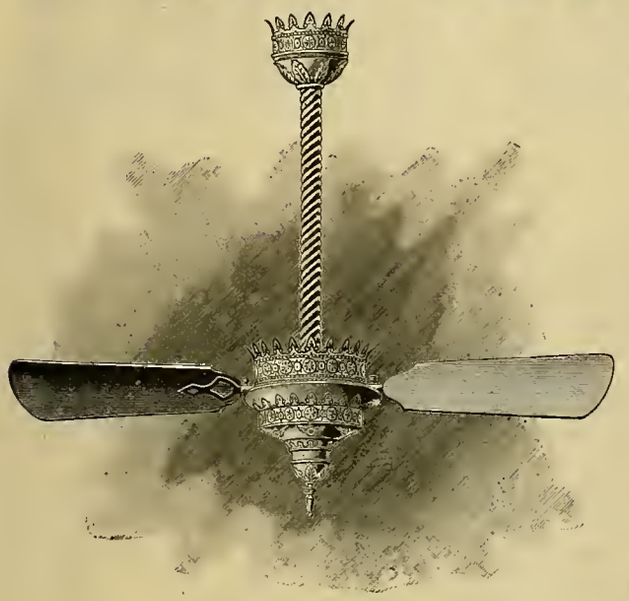
Water Wheels.
Am. Impulse Wheel Co.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Wire, Bare.
Besly & Co., Chas. H.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co
Standard Underground C. Co
Washburn & Moen Mfg. Co.

X Ray Outfits.
Central Electric Co.
Commercial El. Supply Co.
Queen & Co.

For Alphabetical Index of Advertisements See Page III.

DIEHL ELECTRIC FANS.



WOUND FOR ALL CURRENTS, EXCEPT ALTERNATING.

New Designs for this Season.

Ceiling Fans,
Column Fans,
Propeller Fans.

HIGHEST EFFICIENCY. GREATEST DURABILITY.

Our finest designs are ornamented with solid cast brass.

OUR '97 FAN CATALOGUES ARE NOW READY.

Any of Our Fans Furnished with Four Blades if so Ordered.

SHOW ROOMS:
NEW YORK, 561-563 Broadway. BOSTON, 128-132 Essex Street.
CHICAGO, 192-194 VAN BUREN STREET.

DIEHL MANUFACTURING CO.,

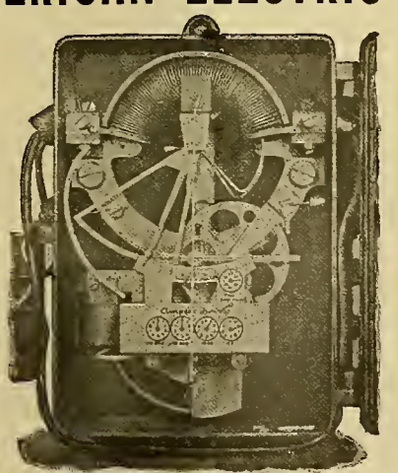
ELIZABETHPORT, N. J.

Agents for Canada: CANADIAN GENERAL ELECTRIC CO., 65-71 Front St. West, Toronto, Ont.

THE AMERICAN ELECTRIC METER.

Designed for all Forms of Service.

Send for circulars and price lists.



3-Wire 22-Light Meter. Case Open, Showing Mechanism.

The . . . American Electric Meter Co.,

Cor. 9th Street and Montgomery Ave.,

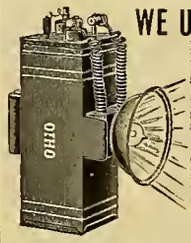
PHILADELPHIA, PA.

"H" BELL

EASY RINGER.
PIVOTED ARMATURE,
DOUBLE ADJUSTMENT.
SEND FOR CATALOGUE.

HUEBEL & MANGER,
MANUFACTURERS,
290 Graham St., Brooklyn, N. Y.

It gives a light that's white and bright,
And two cents is the cost per night.



WE UNDERSELL ALL!

Bicycle Electric Lights	$4.00
Necktie Electric Lights	1.50
Edison Electric Motors	1.00
88 Medical Batteries	3.95
Electric Bells, finest	.25
Dry Batteries, best	.25
$100 Bicycles, best made	39.00
$1.25 Bicycle Bells	.59

Agents Wanted.

Our Bicycle Electric Light is the best thing that ever happened. Catalogue free.

Ohio Electric Works,
13 S. Water St.,
Cleveland, Ohio.

Westinghouse Polyphase Apparatus Supreme.

Generators, Motors, Transformers, for Two-Phase, Three-Phase and C. F. Scott Two-Phase Three-Phase System of Alternating Current Power Transmission.

26,000 H. P. IN OIL-INSULATED TRANSFORMERS CONSTRUCTED.

Potentials from 5,000 to 50,000 Volts. All Apparatus Necessary for 100 Mile Transmission.

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.,

PITTSBURG, PA.

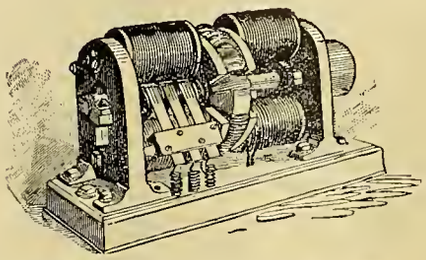
New York, 120 Broadway.
Boston, Exchange Bldg.
Buffalo, N. Y., 8 Erie Co. Bank Bldg.
Charlotte, N. C., 36-38 College St.
Chicago, N. Y. Life Bldg.
Philadelphia, Girard Bldg.
Pittsburg, Westinghouse Bldg.
St. Louis, American Central Bldg.
San Francisco, Mills Bldg.
Syracuse, N. Y., Bastable Bldg.
Tacoma, Wash., 102 S. 10th St.
Atlanta, Ga., Equitable Bldg.
Westinghouse Electric Co., Ltd.,
32 Victoria St., London, S.W., England.
For Canada address
Ahearn & Soper, Ottawa, Ont.

THE BRUSH ELECTRIC COMPANY.

BRUSH

THE BRUSH ELECTRIC COMPANY.

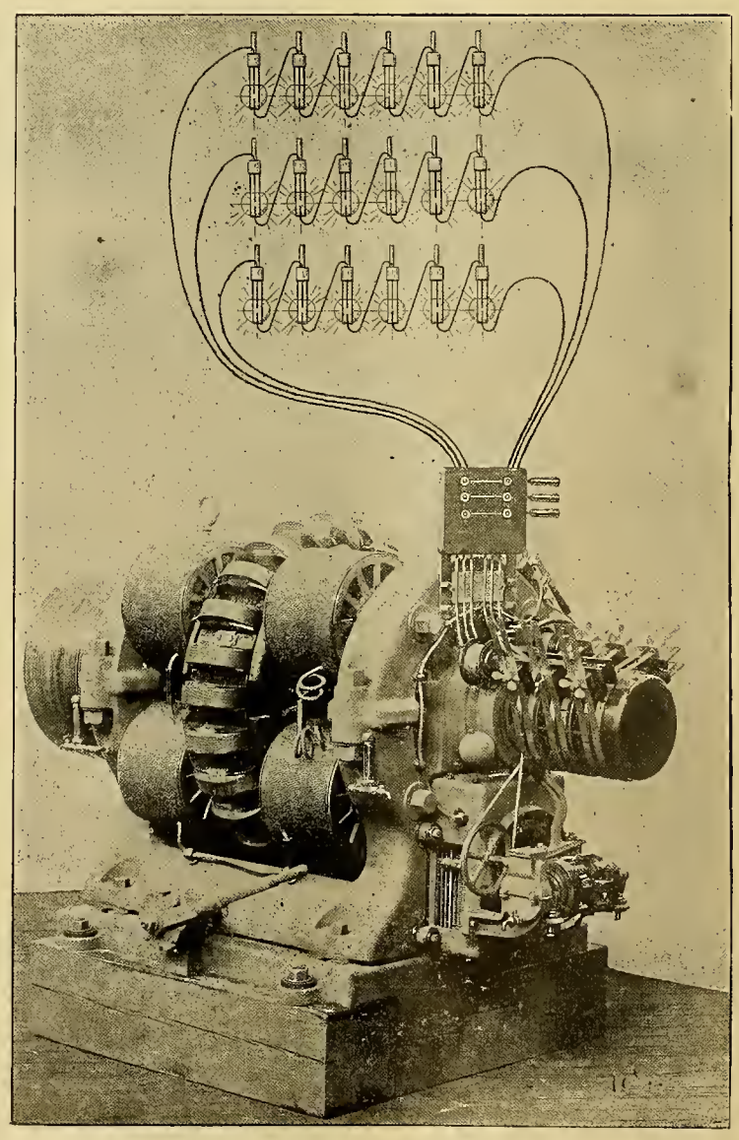
Brush apparatus has been on the market for 20 years. A majority of customers order supply parts direct from us. Many do not. We want this trade and are reducing our prices in order to secure it. Ask for quotations and send orders to the nearest Sales Office.



FIRST BRUSH ARC DYNAMO—1877.

SALES OFFICES:
Schenectady, N. Y.
Cleveland, Ohio.
Boston, Mass., 180 Summer Street.
New York, N. Y., 44 Broad Street.
Philadelphia, Pa., 509 Arch Street.
Cincinnati, Ohio, 420 West Fourth Street.
Chicago, Ill., Monadnock Building.
St. Louis, Mo., Wainwright Building.
Atlanta, Ga., Equitable Building.
Denver, Colo., Kittredge Building.
San Francisco, Cal., 15 First Street.
Toronto, Ont., Canadian General Electric Co., Ltd.
Pittsburg, Pa., Carnegie Building.

Many stations have exchanged all their small units for large Brush arc dynamos. Among them are the Brooklyn-Citizens with 3000 lights capacity. Brooklyn-Municipal 800, Newark 3000, Cleveland 1800, Philadelphia Brush 1500, Philadelphia-Northern 1300, Buffalo 1500, Worcester 1400, Toronto 900, Quebec 625, Harrisburg 750, Erie 750, Albany 500, Troy 500, Paterson 500, City of Chicago 400, John Wanamaker 625, Carnegie Steel Co. 500.



BRUSH MULTI-CIRCUIT 125 LIGHT ARC DYNAMO—1897.

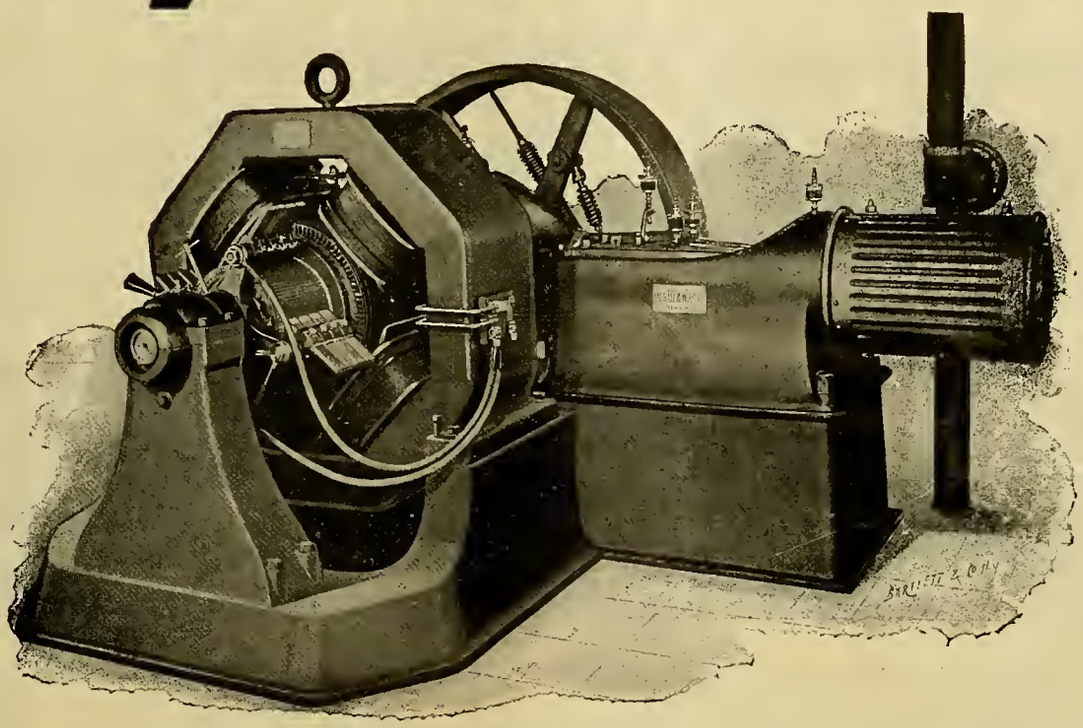
Over 40,000 lights capacity in large Brush arc dynamos sold. A large proportion of them using Multi-Circuit Dynamos.

The newly designed Brush dynamos have the following capacities; 55, 80, 100, 125, 240, 300, 2000 candle-power lights, 45, 85, 120, 160, 1200 candle-power lights.

Brush arc lamps were first used in 1877. More of them being sold to-day than ever before.

Two or more separate circuits run direct from one dynamo with any distribution of load on the different circuits. The advantages are absolute flexibility in handling of circuits; reduction of high voltages on circuits run from large dynamos; use of large units with corresponding increase of efficiency; saving in floor space, oil, belts, shafting, pulleys, attendance.

Eddy Generators



Direct Connected or Belted for Electric Railways, Central Stations, Isolated Lighting or Power Plants.

EDDY MOTORS—SLOW, MEDIUM OR HIGH SPEED.

We build all necessary apparatus for the transmission of Electrical Power through factory or other buildings.

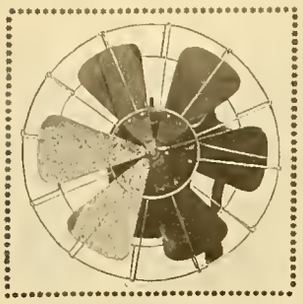
All Our Apparatus Guaranteed as Represented.

The Eddy Electric Manufacturing Company,

WINDSOR, CONN.

New York, H. B. Coho & Co., Mail and Express Building.
Philadelphia, Walter C. McIntire & Co., 506 Commerce St.
Boston, G. M. Angier & Co., 64 Federal St.
San Francisco, Cal., California Electrical Works, 409 Market St.
Elmira, S. N. Blake.
St. Louis Western Electrical Supply Co.
Kansas City, W. T. Osborn.
Cincinnati, O., John A. Stewart.

Western Office: 204 Dearborn St., Chicago, Wallace & Hine, Western Agents.



The Gem Water Motor Fan.

Novel in Construction. **Simple,** **Effective,**
As Easily Installed as an Electric Fan Motor. **Economical,** **Noiseless.**
Discounts for Exclusive Agents. Correspondence Solicited. List Price, $10.00.

JUST THE THING FOR SUPPLY HOUSES TO CARRY.

Agents Wanted.

THE SCHNEIDER MFG. CO., 1134 Hamilton Street, CLEVELAND, OHIO.

McGILL & POMEROY, 1129 Monadnock, Chicago, Ill., Agents for Indiana, Illinois, Missouri, Iowa, Wisconsin, Michigan.

BUCKEYE

QUALITY UNEQUALED
FACTORY PRODUCTION TRIPLED.

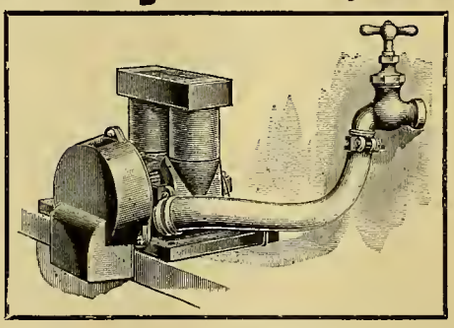
INCANDESCENT LAMPS.

Monadnock Building, Chicago. **THE BUCKEYE ELECTRIC CO., Cleveland, Ohio.**

WESTERN ELECTRIC CO.

CHICAGO. **SUPPLIES**

Water Motor and Dynamo, Complete as shown, ready to attach to faucet, Price, $8.00



Weight, packed in box, 16 lbs.

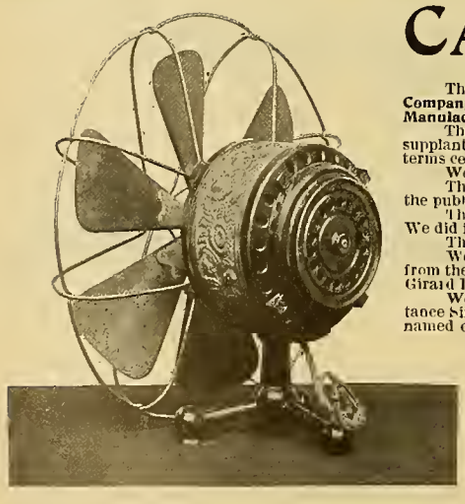
Will charge storage batteries for bicycle lights and for medical apparatus.

Will light small incandescent lamps.

Direct current for general experimenting.

☞Stamp for catalogue.

THE CARLISLE & FINCH CO., - 832 W. 6th Street, Cincinnati, Ohio.



CARD TO THE PUBLIC.

The **General Electric Company, Westinghouse Electric Company, Thomson-Houston Electric Company** and the **Tesla Electric Company** have brought suits against the **Scott & Janney Electric & Manufacturing Company** for "alleged infringements" of their various patents.

This is the **USUAL "BLUFF"** that is brought to bear upon those whose inventions are bound to supplant the inventions of the above named and other large electrical concerns, who cannot at their own terms control such new inventions.

We are manufacturing under **our own patents and are not infringing.**

The above named firms are suing us upon a small fan motor as an excuse to get a chance to make the public believe that the state of the art is not history as far as they know it.

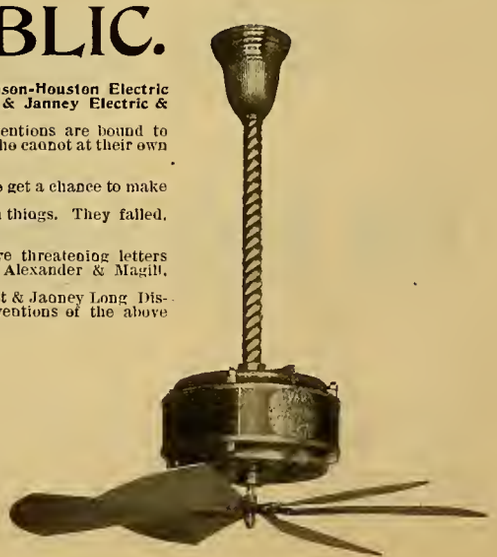
They have spent millions of dollars trying to invent apparatus to do certain things. They failed. We did invent it and have had it patented all over the world. **AND IT WORKS.**

They will try by strategy to do what they dare not do openly.

We wish to ask that the dealers and others who have received or will receive threatening letters from the above named concerns, will please send same to our attorneys, Messrs. Alexander & Magill, Girard Building, Philadelphia.

We are in the field to stay and do not propose to be intimidated. The Scott & Janney Long Distance Single Phase Alternating Railway and Power System will supersede the inventions of the above named companies. **AND THEY KNOW IT.**

FULL PROTECTION GUARANTEED TO ALL PURCHASERS OF OUR APPARATUS.



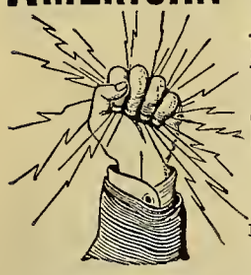
The Scott & Janney Electric and Mfg. Co.,

1707-1709 Filbert Street, PHILADELPHIA.

EUGENE F. PHILLIPS, Prest. F. N. PHILLIPS, Treas. W. H. SAWYER, Secy.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,

ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,

Railway Feeder and Trolley Wire,

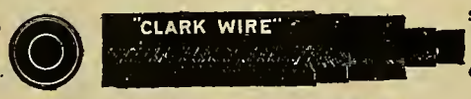
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.

CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, P. C. Ackerman, 10 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 241 Madison St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.

THE "CLARK" WIRE.

FOR SWITCHBOARD, RAILWAY and MOTOR USE.



All sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

Inspector Boston Fire Underwriters' Union says:
"A thoroughly reliable and desirable wire in every respect."

The Clark wire has been before the public and in use for the past ten years, and has met with universal favor. We guarantee our insulation wherever used. Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first-class insulated wire. We shall be pleased to mail Catalogues, with terms and discounts for quantities.

EASTERN ELECTRIC CABLE COMPANY,

HENRY A. CLARK, Treas. and Gen'l Manager.
HERBERT H. EUSTIS. Pres. and Electrician.

61-63 Hampshire Street, BOSTON, MASS.

Fort Wayne Electric Corporation,

FORT WAYNE, IND.

Apparatus for

Arc, Direct Current and Alternating Incandescent Lighting and Power Transmission.

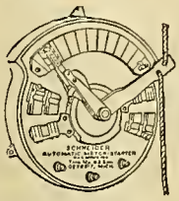
THOS. MUIR & SON,

13 Larned St. W., ... DETROIT, MICH.,

Manufacturers and Selling Agents for

Card Electric Co., Dynamos.
"Lundell" Motors and Fans.
"Imperial" Incandescent Lamps.
Interior Conduit, Brass and Iron.
Insulated Wires.
Insulating Tapes, Etc.
"Detroit" Medical Batteries.

OUR NEW ELEVATOR AUTO-MOTOR STARTER.



110, 220, 500 Volts.

Estimates Given on Elevators.

GET OUR PRICES.

OUR NEW Aluminum-Lined REFLECTORS.

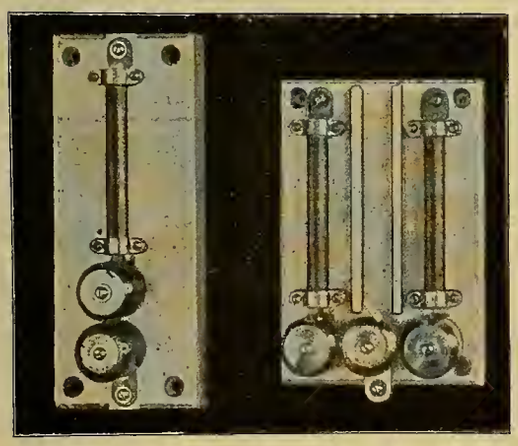
INCANDESCENT AND WELSBACH LIGHTS MADE BRILLIANT.

A NON-ARCING FUSE.

A RELIABLE AND ACCURATE FUSE.

A FUSE that will open a High-Tension Short Circuit without ARC OR FLASH.
Endorsed by the National Board of Underwriters.

53 Aborn St. D. & W. FUSE CO., Providence, R. I.



Wirt Short-Gap Lightning Arresters

For Alternating Current Circuits of any Potential.

Will take the discharge when large gap arresters fail to protect. Small current only at time of discharge. No moving parts.

These Arresters protect the Niagara-Buffalo Transmission and most of the Important Long Distance Transmissions using High Voltage Currents. Write for prices.

SINGLE POLE 1,000 VOLTS. DOUBLE POLE 1,000 VOLTS.

General Electric Company,

MAIN OFFICE: SCHENECTADY, N. Y.

Sales Offices in all Large Cities of the United States. For Canada address Canadian General Electric Company, Toronto.

The Brady Mast Arms.

T. H. Brady, New Britain, Conn., U. S. A.,

Manufacturer of Mast Arms, Pole and Swinging Hoods, House Brackets and other Specialties for Construction Work.—*Catalogues and Prices furnished on application.*

"AMERICAN" STORAGE CELLS

ARE THE BEST. Send for Descriptive Circular.

Absolutely Non-Infringing. Protection Guaranteed.

AMERICAN BATTERY CO., 38 W. Quincy St., Chicago, Ill.

EVERYTHING IN WIRE.

BARE AND INSULATED.

ALSO MANUFACTURERS OF THE "CHICAGO" RAIL BOND.

WASHBURN & MOEN MFG. CO.,

WORCESTER, MASS.

BRANCH OFFICES AND WAREHOUSES: New York, Chicago, San Francisco, Houston, Philadelphia, Pittsburg, Boston.

WEATHERPROOF WIRE.

—AGENCIES:—

Western Electric Co., New York.
Electric Appliance Co., Chicago.
Pettingell Andrews Co., Boston.
Electrical Engineering Co., Minneapolis.
St. Louis Electrical Supply Co., St. Louis.

Phillips Insulated Wire Co.,

Office and Factory: PAWTUCKET, R. I.

WANTED.

Competent man to take charge electrical repair shops. Must fully understand rewinding armatures of all makes. One who has worked in T.-H. or Westinghouse shops preferred. Must have experience and come well recommended. Good salary to right man. "X. Y. Z.," care WESTERN ELECTRICIAN, 510 Marquette Building, Chicago.

WANTED.

Position as superintendent of electric lighting or power plant by man with twelve years' experience in building and operating plants. I can give the best of references as to ability and character. Would be pleased to hear from parties wanting a No. 1 hustler. Address "Hustler," care WESTERN ELECTRICIAN, 510 Marquette Building, Chicago.

WANTED.

Position as engineer and electrician of light plant by a man of 6 years' experience in running light plant and water works. Strictly temperate and can give first-class references as to ability and character. Would be pleased to hear from parties who want a sober, industrious electrician and engineer. Address "Temperate," care WESTERN ELECTRICIAN, 510 Marquette Building, Chicago.

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An experienced electrical engineer, at present connected with a multiphase power transmission plant, having a thorough experience with incandescent and arc lighting and railway apparatus, and seeing no immediate prospect of advancement, desires to find position as superintendent with some company that can reasonably promise advancement according to worth. Address "S. S.," care Elbert Wakeman, Attorney, 93 Nassau St., New York.

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Winders direct from T.-H. and Westinghouse shops. Work guaranteed. Ten years' experience. Light plants installed complete. Send for prices.

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Always in the market for scrap Dynamos, Motors, Wire, Copper, burned out Incandescent Lamps and Lamp bases, etc. Address **THE CORNMAN COMPANY**, 1134 Hamilton St., Cleveland, Ohio.

FOR SALE.

Electric light plant and franchise; no competition. All in a No. 1 order. In one of the best county seat towns in Iowa, with a good and constantly increasing business. Will sell entire plant or half interest to a practical man who has the cash. No others need apply. For full particulars address J. F. Babcock, New Hampton, Iowa.

FOR SALE.

Electric light plant and franchise. No other competing electric or gas plants. Will sell entire or part interest to responsible party. Standard Electric Co., Clinton Wis.

PROPOSAL.

Bids for lighting the streets and public squares of Oneida, Madison County, N. Y., with electricity, for five years, will be received up to 8 o'clock p. m., July 9, 1897. Write to undersigned for specifications.

H. L. BONNEY, Clerk,
Oneida, Madison County, N. Y.

By order of the Board of Trustees.

Notice to Contractors for Electric Lighting.

The village of Bellevue, Ohio, will receive sealed proposals at the office of the Village Clerk of said village until 12 o'clock at noon, July 21, 1897, for the lighting with electricity the streets, alleys, and public places of said village, from dusk until dawn, and from dusk until 12:30 a. m., all dark hours for the term of five (5) years, and for a term of seven (7) years from May 1, 1898.

The bids will be accepted and considered upon the plans and specifications for lighting the village now on file in the clerk's office.

It is particularly understood that the council reserves to itself the right to reject any or all bids under this notice.

W. H. DIMICK,
Village Clerk.

Bellevue, Ohio, May 26, 1897.

Bargains in Street Railway Apparatus.

MOTORS.

	Price each.
4 G. E. 800 motors	$185.00
2 Steel motors, "C" No. 3	200.00
4 Walker motors, 30 h. p.	175.00
2 Westinghouse No. 12, 30 h. p.	150.00
10 " No. 12, 20 h. p.	160.00
23 " No. 3, 25 h. p.	150.00
24 Edison No. 6, 15 h. p.	65.00

GENERATORS.

Edison, T.-H., Detroit, Rae. Write for prices.

TRUCKS.

20 McGuire old style trucks, 25 Brill trucks, Cars and Trailers. Write for photos and prices.

The Electrical Exchange,
Long Distance Tel. 744 Express.
166-174 S. Clinton St., Chicago.

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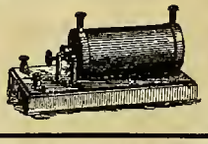

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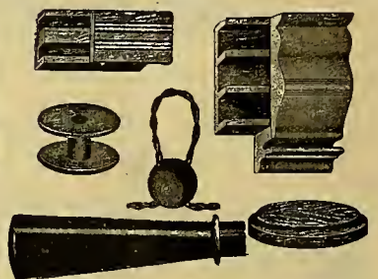

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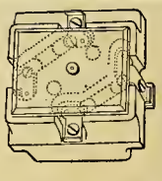

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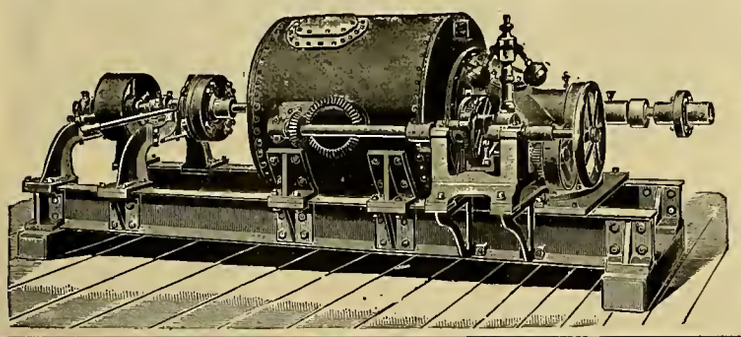

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The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high speed and great efficiency and large capacity** for its **diameter,** being **double** the **power** of most wheels of the same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

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We are now prepared to furnish Victor Turbines, either single or in pairs, on horizontal shafts and where the situation admits of their use we recommend them.

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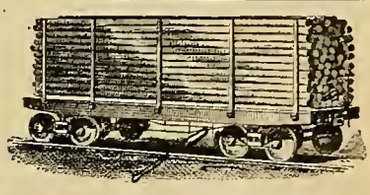

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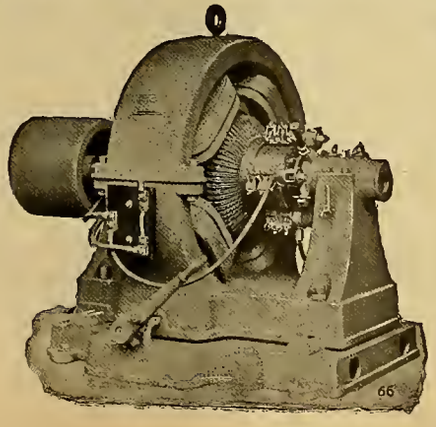

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THE TELEPHONE HAND-BOOK

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"This little book has no pretension to be considered a complete treatise on telephony as it exists in America. The time for such a work is not yet come. But it is felt that there is a demand for a practical book on telephone working and management, and the TELEPHONE HAND BOOK is an attempt at meeting that demand. With the exception of a few chapters dealing with certain forms of transmitters and receivers used in Europe, which are given for the information of those who may wish to engage in the manufacture of telephones, the book is based entirely on standard American practice; and most of the material, apparatus and methods described are peculiar to or have originated in this country."

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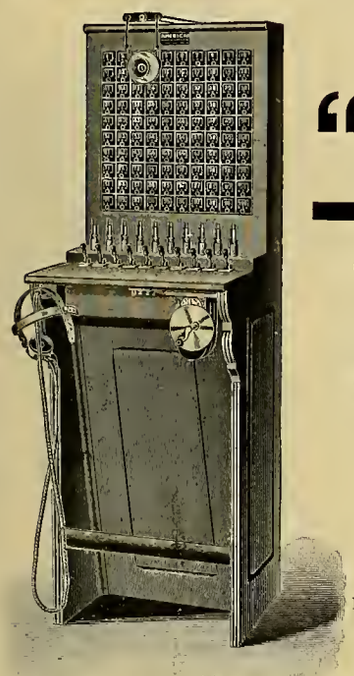

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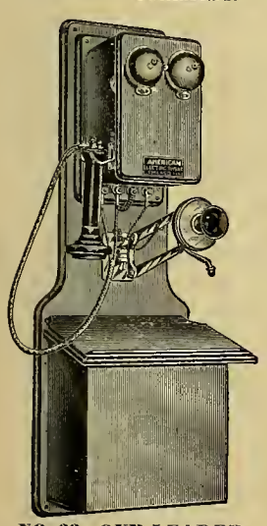

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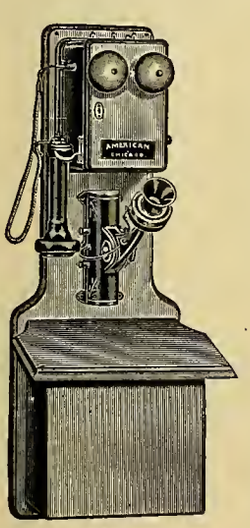

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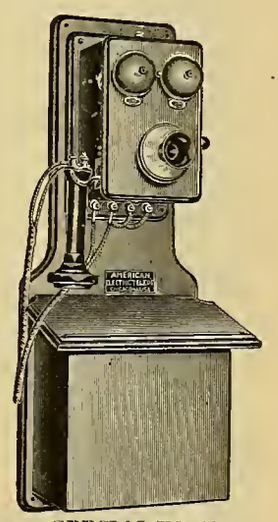

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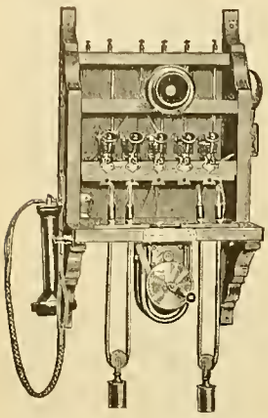

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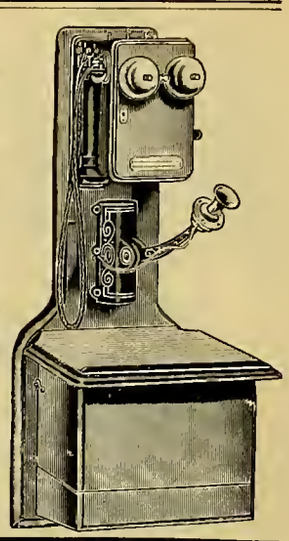

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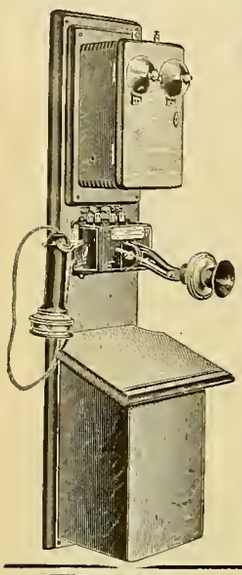

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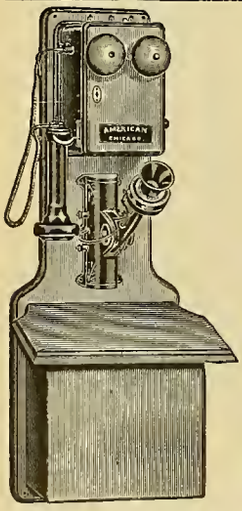

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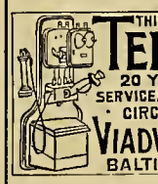

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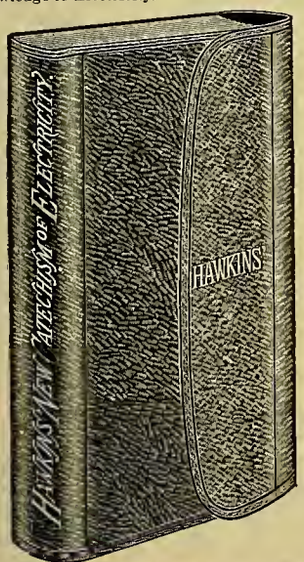

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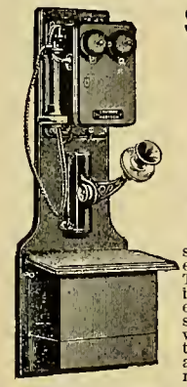

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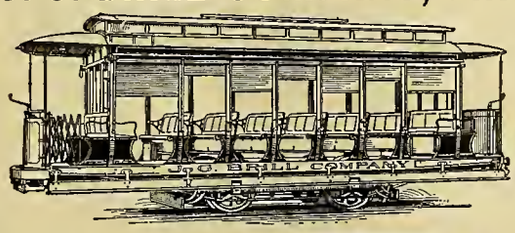

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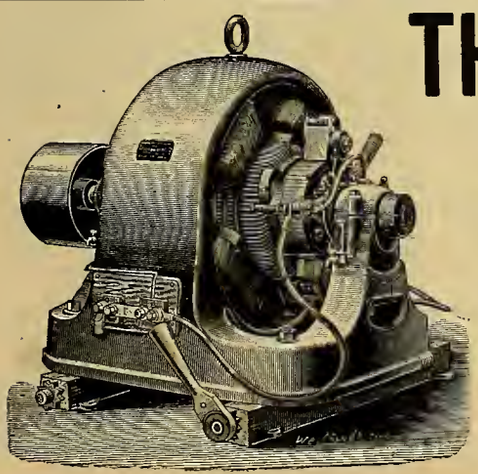

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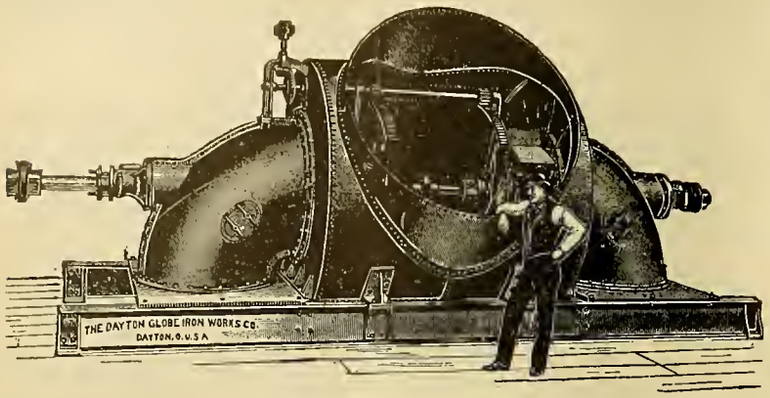

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Whole Gate	16.33	128.00	134.18	199.56	80.50
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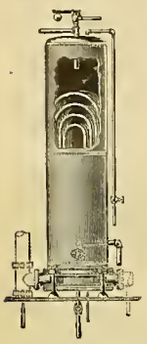

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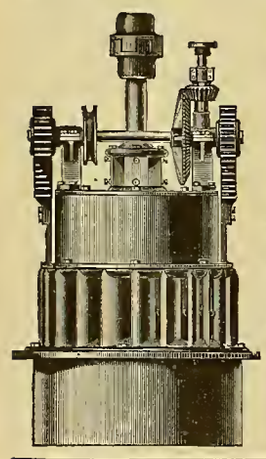

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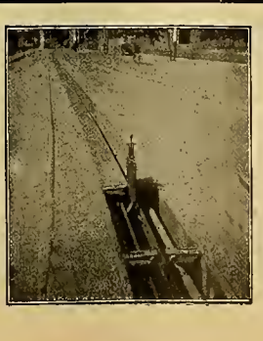

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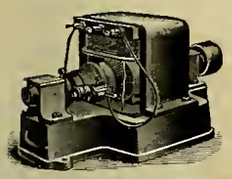

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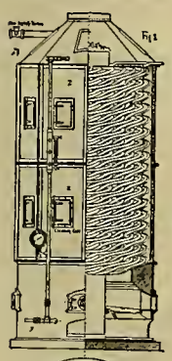

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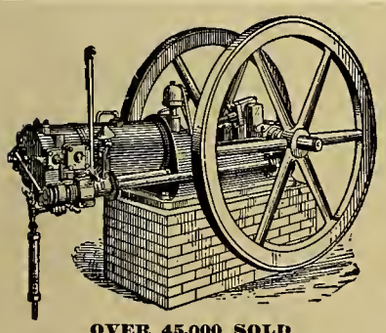

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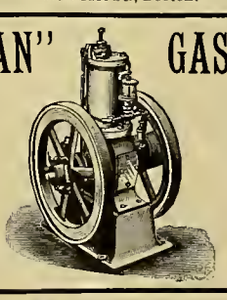

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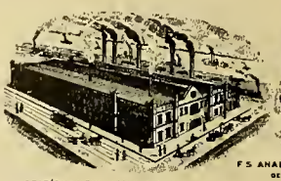

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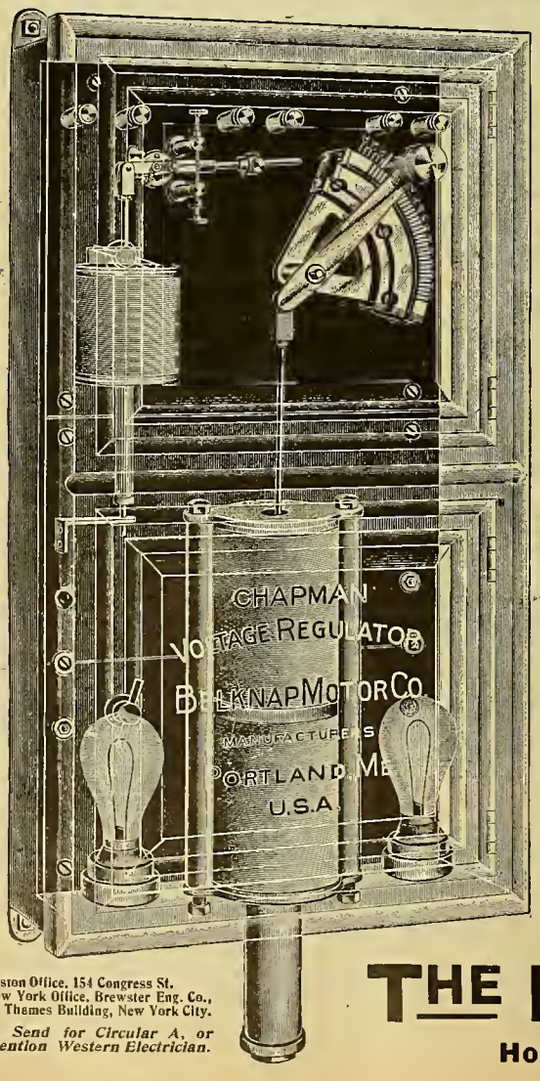

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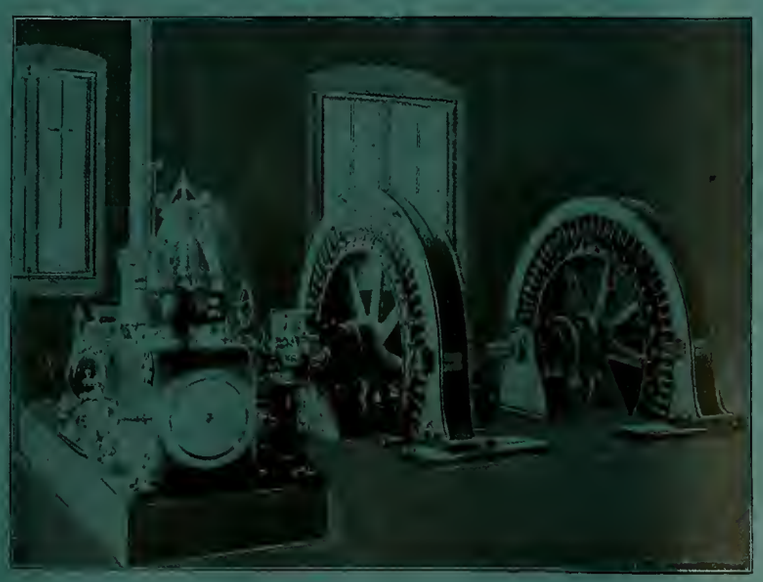

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320 Dearborn St., Chicago, Ill.

GENTLEMEN:—After carefully considering the merits of the various brands of wire upon the market, we have decided to use your "Raven White Core" exclusively for rewiring the Ferris Wheel.

As you are aware, the wire upon the wheel is very much exposed and the test will no doubt be a most severe one.

Yours very truly
THE FERRIS WHEEL CO.
By L. V. Rice. Mgr.

GRIMSHAW WHITE CORE. Used exclusively for all Incandescent Lighting at World's Columbian Exposition.
RAVEN WHITE CORE. Used in some of the largest buildings in the United States.
COMPETITION LINE WIRE. Used by some of the largest Central Stations and Fire and Police Departments in the U. S.
GRIMSHAW TAPES, COMPETITION TAPES AND SPLICING COMPOUNDS.

New York Insulated Wire Company,
MAIN OFFICE: 13-17 Cortlandt St., New York.
BRANCHES: CHICAGO: 320 Dearborn St. BOSTON: 134 Congress St. SAN FRANCISCO. 115 New Montgomery St.

Black Diamond File Works.
Est. 1863. Inc. 1895.

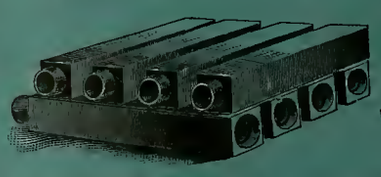
Twelve Medals Awarded at International Expositions.

Special Prize Gold Medal at Atlanta, 1895.

Our goods are on sale in every leading Hardware Store in the United States and Canada.

G. & H. BARNETT COMPANY,
PHILADELPHIA, PA.

N. B. BUBB, Manager. J. M. CHESNUT, Supt.
WILLIAMSPORT WOODEN PIPE CO.,
MANUFACTURERS OF
WOODEN CONDUIT,
UNDER CHESNUT PATENT.
Write for Information and Save Money.
WILLIAMSPORT, PA.



AN EXTENSIVE AND IMPROVED CREOSOTING WORKS ATTACHED TO THE PLANT.

For underground electrical purposes the conduit produced under this process is the most practical, the most durable and the most economical of any conduit on the market.

This conduit is now being used in the leading cities, and the best of references furnished on application.

= = THE = =
WARREN ALTERNATOR.

A Dynamo
without Collector Rings or Commutator, without Brushes, without Moving Wires, without liability to "Burn Out."
Induction Type,
Any Voltage or Multi-Voltage.
Stationary Armature.
Stationary Field.

An
Unqualified Success.
As demonstrated by two years' hard service, and now we are on the
War Path
for Business.

NOISELESS IN OPERATION.
A MONEY EARNER.

Warren Electric Manufacturing Co.,
SANDUSKY, OHIO.

WESTERN ELECTRICIAN

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Vol. XXI. CHICAGO, JULY 10, 1897. No. 2

SIMPLEX INSULATED WIRES AND CABLES.

RUBBER COVERED, WEATHERPROOF, UNDERGROUND AND SUBMARINE.

WESTERN SELLING AGENT. H. R. HIXSON, 1137 Monadnock Block, CHICAGO.

Simplex Electrical Company, 75-81 Cornhill, BOSTON, MASS.

ALFRED F. MOORE,

MANUFACTURER OF

INSULATED ELECTRIC WIRE,

FLEXIBLE CORDS AND CABLES.

200 AND 202 NORTH THIRD STREET, - PHILADELPHIA, PA.

OKONITE

TRADE MARK.

1889—Paris Exposition, Medal for Rubber Insulation.

1893—World's Fair, Medal for Rubber Insulation.

THE STANDARD FOR RUBBER INSULATION.

Sole Manufacturers of

Okonite Wires, Okonite Tape, Manson Tape, Candee Weather-proof Wires.

253 BROADWAY, NEW YORK.

Willard L. Candee, H. Durant Cheevar, } Managers. Geo. T. Manson, Gen'l Supt. W. H Hodgins, Secy.

JEWELL DYNAMO BELTING

Jewell Belting Co.,

TANNERS OF

OAK BELTING LEATHER,

Manufacturers of....

High Grade Oak Belting,

HARTFORD, CONN.

Have You Seen Our Dog?

He is a great seller these hot days. He is easily kept, as he eats nothing but electricity, and only a little of that. He is not particular whether it is alternating or direct current, and he always repays the person who feeds him by heating up their curling iron to perfection.

Send for circular and prices.

MANUFACTURED BY

AMERICAN ELECTRICAL HEATER CO.,

197 River Street, Detroit, Mich.

WESTON Electrical Instrument Co.,

114-120 William St., NEWARK, N. J., U. S. A.

Weston "Round Pattern" Voltmeter.

We desire to call attention to a line of **cheap** but excellent Switchboard Instruments for Direct Current Circuits, which we designate as

"Round Pattern," Type F.

These Instruments are particularly suitable for Isolated Plants and Feeder Circuits in Railway and Power Plants. Voltmeters in ranges from 3 to 750 volts. Ammeters in ranges from 1 to 2,500 amp. All Weston Instruments are unsurpassed in excellence of workmanship, in accuracy and economy of operation.

Mention the WESTERN ELECTRICIAN when writing

HIGHEST AWARDS

PARIS 1867. CHICAGO 1893. PHILADELPHIA 1876.

DAYS KERITE

INSULATED WIRES AND CABLES.

AERIAL, UNDERGROUND, SUBMARINE.

KERITE TAPE.

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Western Office, Marquette Bldg., Chicago, Ill.

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Standard Underground Cable Co.

THE ROOKERY, CHICAGO. WESTINGHOUSE BUILDING, PITTSBURG. 18 CORTLANDT ST., NEW YORK CITY.

Electric Cables, Conduits, Wires and Accessories.

Also High-Grade Rubber Covered Wires and Cables.

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PLATINUM For all Purposes. Scrap and Native Platinum Purchased. BAKER & CO., 408-414 New Jersey Railroad Ave., Newark, N. J.

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Smith & Wallace, Hamilton St., Boston, Mass.
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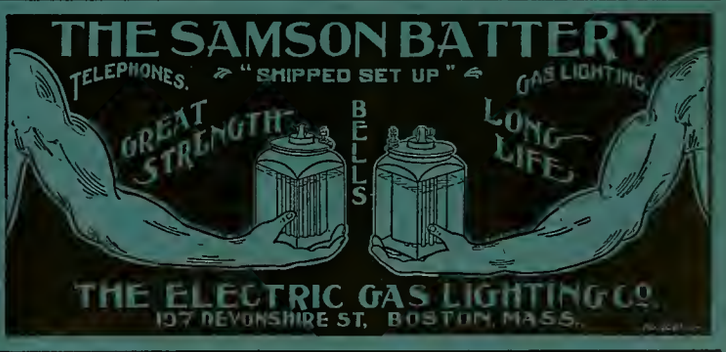
Joshua Hendy Machine Works, 42 Fremont St., San Francisco.
Central Electric Co., 173 Adams St., Chicago.
Harry M. Shaw, 120 Liberty St., New York.

Manufacturers and Dealers PARTRICK & CARTER CO. 125 So. 2nd St. PHILADA. PA. ELECTRICAL HOUSE GOODS.



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FORT WAYNE, IND.

Apparatus for

Arc, Direct Current and Alternating Incandescent Lighting and Power Transmission.

GREEN'S ECONOMIZER

SAVES 10% TO 20% IN FUEL.

SOLE MAKERS IN THE U. S. A.

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BRANCH OFFICES: 74 Cortlandt St., New York;

For Steam Boilers.

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Direct Connected or Belted for Electric Railways, Central Stations, Isolated Lighting or Power Plants.

Eddy Motors—Slow, Medium or High Speed.

We build all necessary apparatus for the transmission of Electrical Power through factory or other buildings.

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BOSTON, G. M. Angier & Co., 64 Federal St.
ELMIRA, S. N. Blake.
ST. LOUIS, Western Electrical Supply Co.
KANSAS CITY, W. T. Osborn.
CINCINNATI, O., Nevada Bldg., John A. Stewart.
CHICAGO, 305 Dearborn St., Wallace & Hine, Managers.
SAN FRANCISCO, CAL., Cal. Elec. Wks., 409 Market St.

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Alcatraz Electrical Compound,

Manufactured by

THE CALIFORNIA ASPHALT CO., 57 East 59th St., NEW YORK.

ABSOLUTELY UNEQUALED FOR

ELECTRICAL AND WIRE INSULATION, Insulating Connections, Dynamos and Motor Bases, Battery and Accumulator Shelving, Circuit and Switch-Boards.
WATER-PROOFING Cut-Out Boxes, coating wires when subjected to acid or alkaline fumes, and when laid under cement, etc.
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COATING CABLES, Lead-Covered Pipes, and all underground work.

ALCATRAZ ELECTRICAL COMPOUND is manufactured of the celebrated brand of Alcatraz Asphalt, and possesses many well-known points of superiority. It has been tried under severe and exacting conditions, and has given perfect satisfaction. **It will not Scale, Crack or Burn. Presents a Smooth Surface. Adheres Tenaciously. Not affected by Thermal or Climatic Conditions. Resists the action of the Elements, Acids, Alkalies, Sewer Gases, and possesses great strength and elasticity.** Being the producers of the raw product, we are enabled to save the middleman's profit, and offer consumers a superior article at a very low price. **SAMPLE UPON APPLICATION. Agents wanted in all leading cities.**

NON-ARCING AUTOMATIC CIRCUIT BREAKERS

GUARANTEED TO OPERATE PERFECTLY OR NO PAY. MADE FOR ALTERNATING OR DIRECT CURRENT. ANY VOLTAGE. CATALOGUE FREE.

AUTOMATIC CIRCUIT BREAKER COMPANY, NEWAYGO, MICHIGAN, U. S. A.

THE K. A. K. CONDUIT SYSTEM.

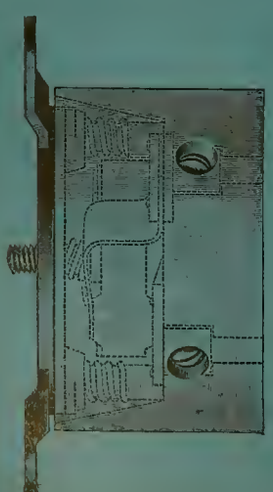
Simple in Construction.

Successfully Stood the Severe Tests of Last Winter's Snowstorms.

Practical in Operation.

SEND FOR FULL PARTICULARS.

KROTZ, ALLEN & KELLY, SPRINGFIELD, OHIO.



IN A PORCELAIN CUP.

This is One Way of Putting Up

PERKINS FLUSH SWITCHES

AND NO EXTRA COST.

All Parts of Switch Insulated. Solid Adjustable Plates Any Size You Want.

PERKINS ELECTRIC SWITCH MFG. CO.,

New York. Hartford, Conn. Chicago.

From the Torch to the "PIONEER" Enclosed Arc Light, the world has gradually advanced through all the stages of improving illumination until now we are practically delivering artificial sunshine. Steady, Clear, Soft, Shadowless, Simple, Economical and Safe.

IN WRITING FOR OUR CATALOGUE, KINDLY MENTION THIS PAPER.

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687 AND 689 BROADWAY,

LOUIS B. MARKS, M. M. E., CHIEF ELECTRICIAN.

. . . . NEW YORK.

PIONEERS IN ENCLOSED ARC LIGHTING — THE PIONEER — TRADE MARK

150 HOURS.

The Best of Incandescent Lamps for 12 cents each.

Send us your burned-out lamps and we will return them at the above price and GUARANTEE them to be equal to the best.

We have a good filament. We procure a vacuum superior to the mercury process.

We renew only those bulbs which have not lost their vacuum, and thus proven that they are without flaw.

We thoroughly clean the bulbs and tighten the loose collars.

Lamps to be renewed should be sent by FREIGHT, as we pay charges to our factory. Be sure your name accompanies shipments and advise us by letter of voltage, base, efficiency and candle power desired.

Lynn Incandescent Lamp Co., Lynn, Mass.

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FAN MOTORS.
CHICAGO EDISON COMPANY,
139 ADAMS STREET, CHICAGO.

THE ORIGINAL PATENTEES AND MANUFACTURERS OF

Cement-Lined Ducts

Engineers and Contractors for Complete Subways.

Address all Correspondence: **NEW HAVEN, CONN.**

The Connecticut Pipe Manufacturing Company,

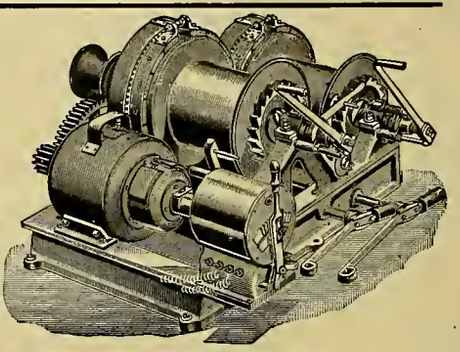
Office and Factory, West Haven, Conn.

Business Established 1865.
Incorporated 1892.

E. H. PHIPPS, President.
GEO. O. RICHARDS, Secretary.
CHARLES WARD, Gen. Mgr.

THE . . .

Storey Motors.



Iron-clad. Completely Closed In. Dust and Moisture Proof. No External Magnetism.

Specially Adapted for Direct Connection to Machinery.

Special Direct Current Motors for All Classes of Work.

THE STOREY MOTOR & TOOL CO.,

MAIN OFFICE AND FACTORY: 212-226 Carter St., Philadelphia, Pa.

CHICAGO OFFICE: Metropolitan Elec. Co., 186-188 Fifth Ave.

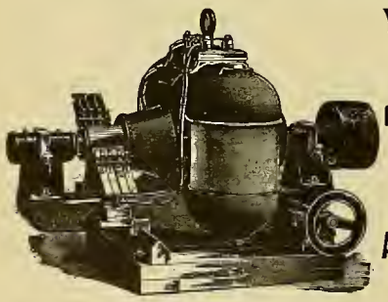
BRANCH FACTORY: Hamilton, Canada.

DALLETT
Electric Motors and Generators,

MANUFACTURED BY

THOS. H. DALLETT & CO.,

York St. and Sedgley Ave.,
PHILADELPHIA, PA.



Portable Electric Drills, Starting Boxes and Controllers,

Automatic Switches. . . . . .
Flexible Insulated Couplings.

Strain Insulators.

Brooklyns, Giants, Globes.

For Span Wires, Anchors and Feeding-in. Perfectly insulated with moulded mica.

VULCABESTON
Controller Parts, Commutator Rings, Bushings, Magnet Spools, Etc.

Strongest, Most Durable. None more widely used.

Send for catalogue **Trolley Insulators,** Section Insulators, Insulated Crossings, Toggle Clamp Feed-Wire Insulator, Granten Rail Bonds, Etc.

H. W. JOHNS M'F'G CO., 240-242 RANDOLPH STREET, CHICAGO.

NEW YORK. PHILADELPHIA. BOSTON.

The Tuerk Alternating Current Ceiling Fan.

1897 PATTERNS NOW READY.

Some New Features Embodied in Our '97 Product Make It Better than Ever.

MADE FOR FROM 50 TO 120 VOLTS.
60, 125 AND 140 CYCLES.

SPECIAL FEATURES:
High Economy.
Self-Oiling Bearings.
Adjustable Blades.
Starting Switch at Bottom.

Five different styles of finish—Bronze, Bower-Barff, Ivory and Gold, Nickel, Polished Brass.

THE HANDSOMEST FAN ON THE MARKET.

Strong, Reliable, Noiseless, Durable, Ornamental and Inexpensive to Operate.

SEND FOR 1897 CATALOGUE.

HUNTER FAN & MOTOR CO.,

FULTON, NEW YORK.

E. B. LATHAM & CO., General Selling Agents, 136 Liberty Street, New York, U. S. A.

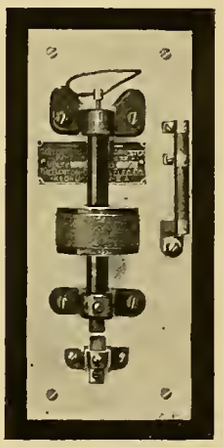
Don't Run Two Plants

Your own and some other fellow's repair shop. Repairs eradicate regular dividends; some repairs arise from regular and natural causes, but most of them are due to accidents. A lightning struck armature or transformer is an accident, and it's for these that we offer you absolute indemnity by the use of the

Garton Lightning Arrester.

It's like a new policeman out for a record—arrests every tramp or sneak current that comes along. If you want protection use it.

Send for Circular.



OKONITE
IT NEVER DISAPPOINTS

Central Electric Company.

1887–1897.

173-175 Adams Street,
CHICAGO.

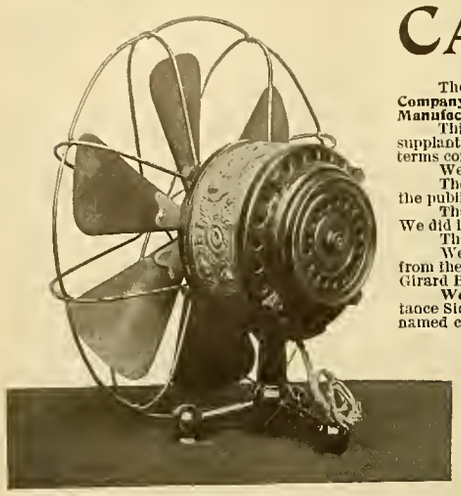
Geo. A. McKinlock, Prest.
Charles E. Brown, Sec'y.
S. R. Frazier, Treas.

The Crocker-Wheeler Electric Company

Have pleasure in announcing that they are established at

Rooms 1514-16 Old Colony Building, Chicago,

For the conduct of their business as manufacturers and electrical engineers, formerly conducted in this territory by Messrs. Sargent & Lundy. Mr. C. H. Wilmerding will have charge of this office as engineer and Western manager, and Mr. Julian Roe has been detailed as salesman. Customers will have, in consequence, the advantage of dealing with the company and of obtaining direct the benefit of its well-known guarantees and its engineering ability, and will have the convenience of direct telegraphic communication with the factory at Ampere, N. J.



CARD TO THE PUBLIC.

The **General Electric Company, Westinghouse Electric Company, Thomson-Houston Electric Company** and the **Tesla Electric Company** have brought suits against the **Scott & Janney Electric & Manufacturing Company** for "alleged infringements" of their various patents.

This is the **USUAL "BLUFF"** that is brought to bear upon those whose inventions are bound to supplant the inventions of the above named and other large electrical concerns, who cannot at their own terms control such new inventions.

We are manufacturing under **our own patents** and **are not infringing.**

The above named firms are suing us upon a small fan motor as an excuse to get a chance to make the public believe that the state of the art is not history as far as they know it.

They have spent millions of dollars trying to invent apparatus to do certain things. They failed. We did invent it and have had it patented all over the world. **AND IT WORKS.**

They will try by strategy to do what they dare not do openly.

We wish to ask that the dealers and others who have received or will receive threatening letters from the above named concerns, will please send same to our attorneys, Messrs. Alexander & Magill, Girard Building, Philadelphia.

We are in the field to stay and do not propose to be intimidated. The Scott & Janney Long Distance Single Phase Alternating Railway and Power System will supersede the inventions of the above named companies. **AND THEY KNOW IT.**

FULL PROTECTION GUARANTEED TO ALL PURCHASERS OF OUR APPARATUS.

The Scott & Janney Electric and Mfg. Co.,

1707-1709 Filbert Street, PHILADELPHIA.

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Electric Appliance Co.
Partrick & Carter Co.

Arc Lamps.
Central Electric Co.
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General Electric Co.
Manhattan Gen'l Cons. Co.
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Perkins Elec. Switch Mfg. Co
Westinghouse El. & Mfg. Co.

Arc Light Cord.
Central Electric Co.
Samson Cordage Wks.

Batteries and Jars.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
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Elec. Gas Lighting Co.
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Edwards & Co.
Electric Appliance Co.
Huebel & Manger.
Ohio Electric Works.
Partrick & Carter Co.

Belting.
Jewell Belting Co.
Main Belting Co.
Peerless Rubber Mfg. Co.
Shultz Belting Co.

Boilers.
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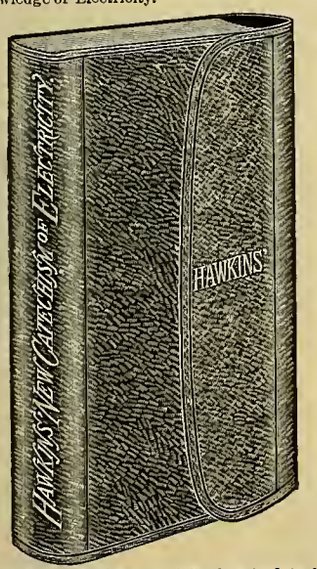

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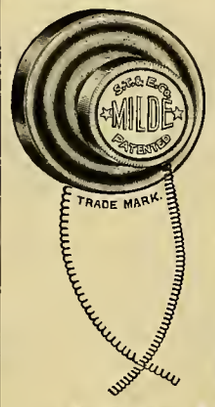

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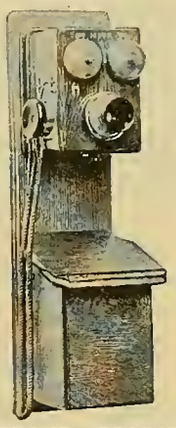

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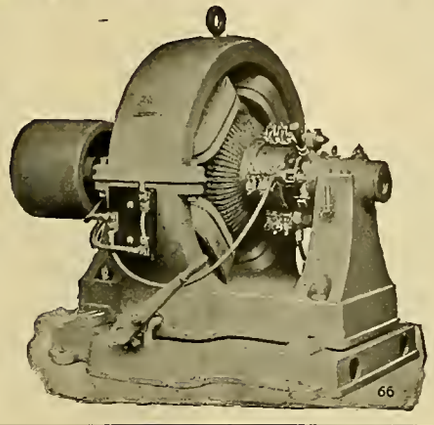

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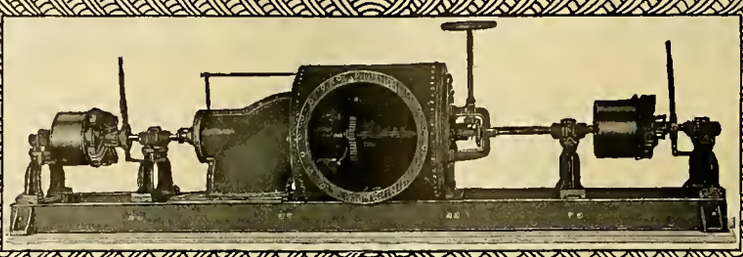

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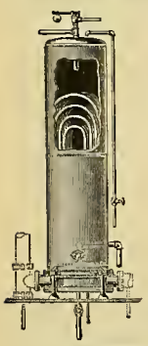

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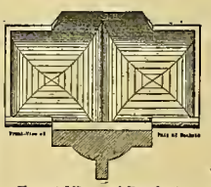

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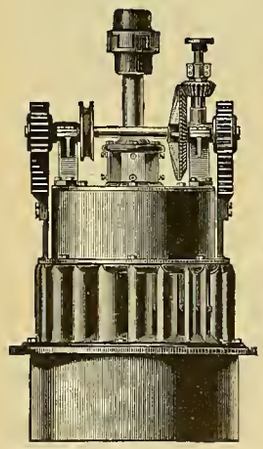

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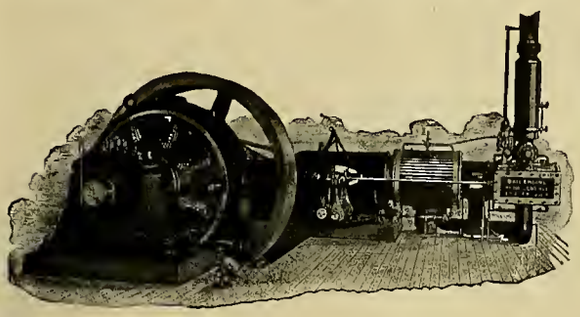

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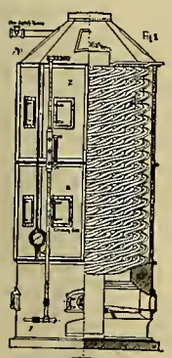

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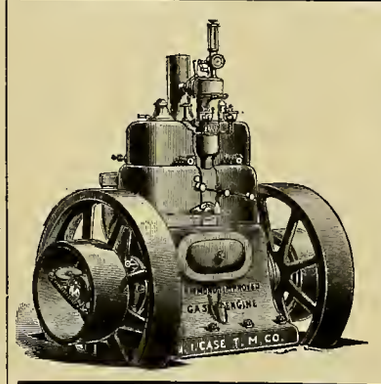

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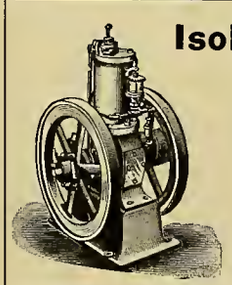

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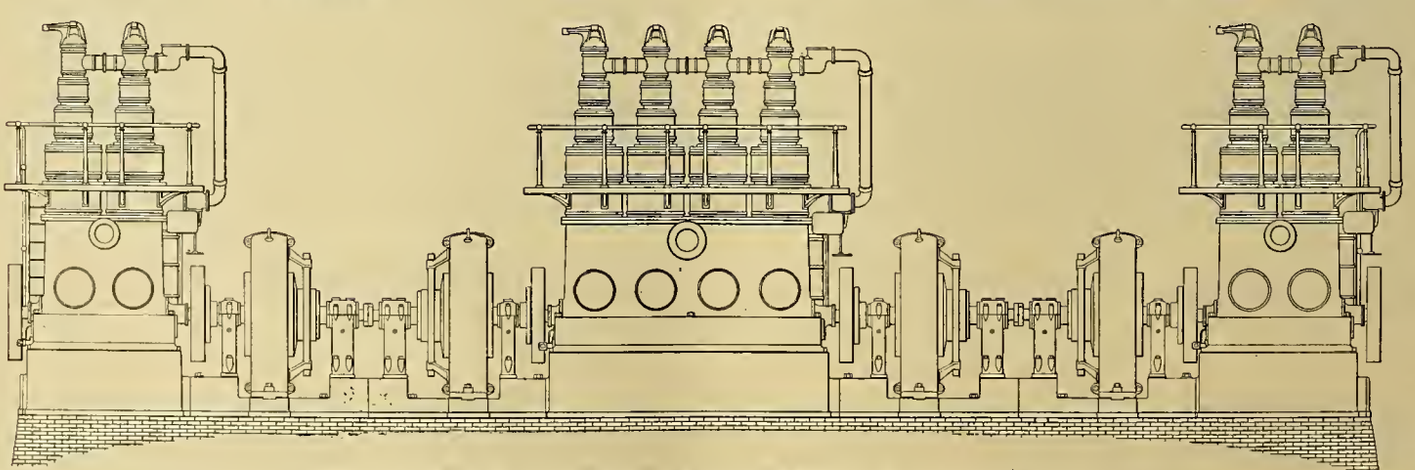

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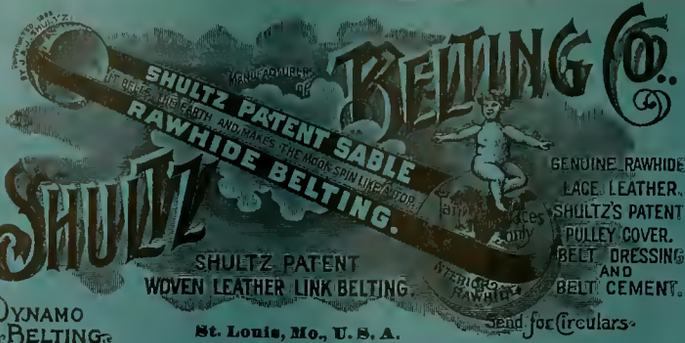

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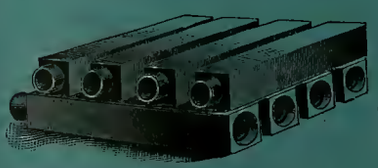

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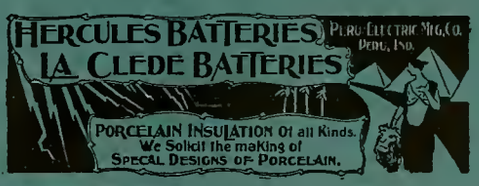

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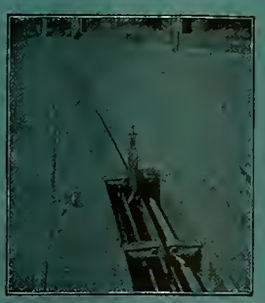

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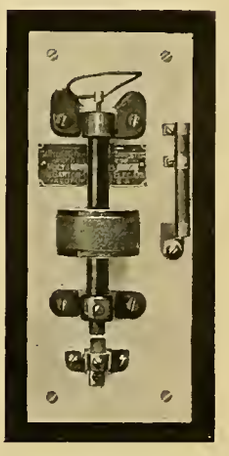

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WRITE YOUR JOBBER FOR REVISED FIGURES.

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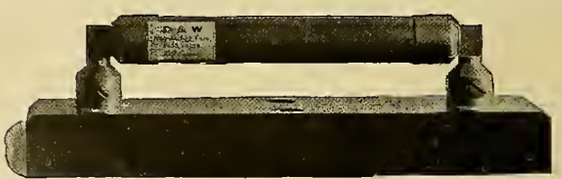
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A FUSE that will open a High-Tension Short Circuit without
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Endorsed by the National Board of Underwriters.
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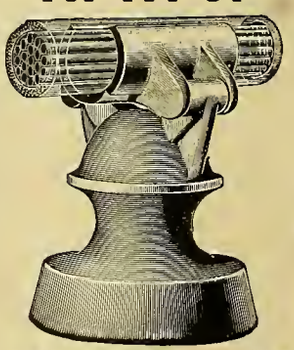
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1897 PATTERNS NOW READY.
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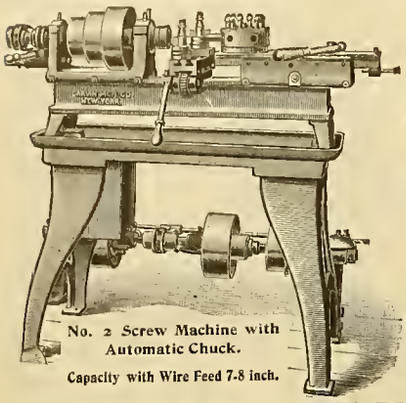

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Peru Elec. Mfg. Co.
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Lever, C. H. Mfg. Co.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
General Electric Co.

Engines, Gas.
Case, J. I., T. M. Co.
Otto Gas Engine Wks.
Van Duzen Gas & Gso. Eu. Co.
Van Horne, Burger & Co.

Engines, Steam.
American Engine Co.
Ball Engine Co.

Fan Outfits.
Central Electric Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
General Electric Co.
Hunter Fan & Motor Co.
Schneider Mfg. Co.
Scott & Janney El. & Mfg. Co.
Western Elec. Co.
Westinghouse El. & Mfg. Co.

Feed Water Heaters.
Davis & Son, I. B.

Fibre.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.
Central Electric Co.

Fixtures, El. & Comb'n.
Central Electric Co.
Commercial El. Supply Co.

Fuses.
D. & W. Fuse Co.

Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
Commercial El. Supply Co.
Electric Appliance Co.

Gaskets.
Johns, H. W., Mfg. Co.
Peerless Rubber Mfg. Co.

Gas Lighting, Electric.
Central Electric Co.

Gears.
Besly & Co., Chas. H.
Central Electric Co.

General Elec. Supplies.
Besly & Co., Chas. H.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
Electrical Supply Co.
General Electric Co.
Genor & Colburn.
Hodge, Walsh & Loring.
International Elec. Co.
Metropolitan Electric Co
Ohio Electric Works.
Palste Co., H. T.
Partrick & Carter Co.
Peoples Electric Co.
Peru Elec. Mfg. Co.

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Central Electric Co.
Commercial El. Supply Co.

Gov'nors, Water Wheel.
Lombard Water Wheel Gv. Co.

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Central Electric Co.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Induction Coils.
Central Electric Co.
International Elec. Co.
Queen & Co.

Insulators and Insulating Materials.
Brixey, W. R.
Bryant Electric Co.
California Asphalt Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
Electrical Supply Co.
Empire China Works.
Hodge, Walsh & Loring.
Johns Mfg. Co., H. W.
Mica Inaulator Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Palste Co., H. T.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Phillips Insulated Wire Co.
Standard Paint Co.
Simplex Electrical Co.
Standard Underground C. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

Lamps, Incandescent.
Buckeye Electric Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
General Electric Co.,
Lynn Incandescent Lp. Co.
Metropolitan Electric Co.
Ohio Electric Works.
Perkins Elec. Switch Mfg. Co.
Sawyer-Man Elec. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

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Studebaker Bros. Mfg. Co.

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Central Electric Co.
Electric Appliance Co.
General Electric Co.
Westinghouse El. & Mfg. Co.

Magnet Wire.
(See Insulated Wires.)

Mechanical Machinery.
Besly & Co., Chas. H.
Garvin Machine Co., The.
Stilwell-Bierce Smith-Valle.

Mica.
Central Electric Co.
Commercial El. Supply Co.
McLaurin & McLaren.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
General Electric Co.
Westinghouse El. & Mfg. Co.

Motors.
Ahlm-Edwards Elec. Co.
American Engine Co.
Belknap Motor Co.
Brush Electric Co.
Bullock Elec. Mfg. Co.
Card Electric Co.
Central Electric Co.
Chicago Armature Co.
Commercial El. Supply Co.
Crocker-Wheeler Elec. Co.
Dallett & Co., Thos. H.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Electrical Supply Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Metropolitan Electric Co.
Muir & Son, Thos.
Northern Electl. Mfg. Co.
Ohio Electric Works.
Peoples Electric Co.
Scott & Janney El. & Mfg. Co.
Stanley Elec. Mfg. Co.
Storey Motor & Tool Co.
Triumph Electric Co.
Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co

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Besly & Co. Chas. H.
Garlock Packing Co.
Johns, H. W., Mfg. Co.
Peerless Rubber Mfg. Co.

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California Asphalt Co.
Central Electric Co.
Commercial El. Supply Co.
Johns, H. W. Mfg. Co.
Standard Paint Co.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co. Ltd.

Platinum.
Baker & Co.

Poles.
Carley, Ira.
Lindsley Bros.
National Tube Works Co.
Perrizo & Sons.
Sterling & Son, W. C.

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Bryant Electric Co.
Central Electric Co.
Commercial El. Supply Co.
Empire China Works.
Peru Elec. Mfg. Co.

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Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Partrick & Carter Co.

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Swarts Metal Refining Co.

Reflectors.
Muir & Son, Thos.

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Belknap Motor Co.

Re-Winding.
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Chicago Edison Co.
Electrical Exchange, The.
Hodge, Walsh & Loring.
National Electric Co.

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Am. El. Heat. Corporation.
Central Electric Co.
General Electric Co.
Iron Clad Rheostat Co.
Leonard, Ward, Elec. Co.
Muir & Son, Thos.
Westinghouse El. & Mfg. Co

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Chicago Armature Co.
Corcoran Co.
Electrical Exchange, The.
National Electric Co.

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Central Electric Co.
Muir & Son, Thos.

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Central Electric Co.
Electric Appliance Co.
Partrick & Carter Co.

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Central Electric Co.
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National Tube Works Co.

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American Battery Co.
Central Electric Co.
Electric Storage Battery Co.
Ohio Storage Battery Co.
Willard El. & Battery Co.

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American Electrical Works.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co
Okonite Co., The.
Simplex Electrical Co.
Standard Paint Co.
Washburn & Moen Mfg. Co.

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Central Electric Co.
Commercial El. Supply Co.
Kusel, D A., Tel. Mfg. Co.
Lockwood T. & T. Co. of Am.
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Orne Elec. Cons. Co.
Peoplea Electric Co.
Standard Tel. & El. Co.
Stromberg-Carlson Tl. M. Co.
Taber & Mayer.
Viaduct Mfg. Co.
Western Tel. Cons. Co.
Whitman & Couch.

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Central Electric Co.
Commercial El. Supply Co.
Diamond Elec. Co.
Ft. Wayne Elec. Corporation
General Electric Co.
Stanley Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

Trolley Cord.
Central Electric Co.
Samson Cordage Wks.

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Brill Co , J. G.
General Electric Co.
Westinghouse El. & Mfg. Co.

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Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle

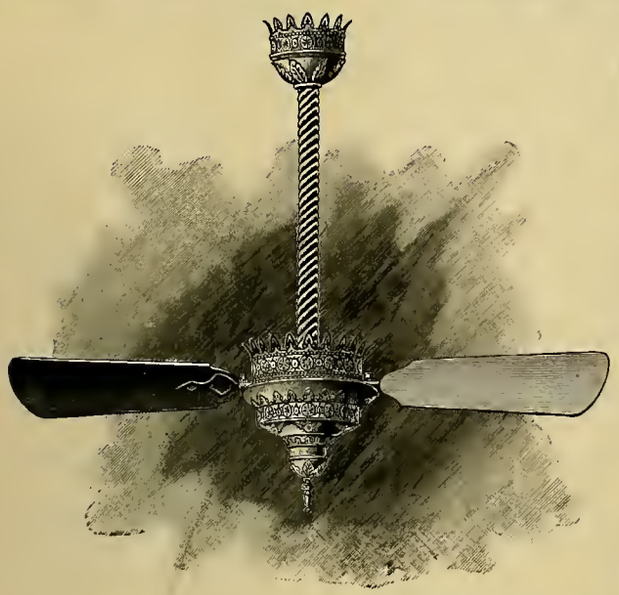
Water Wheels.
Am. Impulse Wheel Co.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle

Wire, Bare.
Besly & Co., Chas. H.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Standard Underground C Co
Washburn & Moen Mfg. Co.

X Ray Outfits.
Central Electric Co.
Commercial El. Supply Co.
Queen & Co.

For Alphabetical Index of Advertisements See Page III.

DIEHL ELECTRIC FANS.



WOUND FOR ALL CURRENTS, EXCEPT ALTERNATING.

New Designs for this Season.

Ceiling Fans,
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Propeller Fans.

HIGHEST EFFICIENCY. GREATEST DURABILITY.

Our finest designs are ornamented with solid cast brass.

OUR '97 FAN CATALOGUES ARE NOW READY.

Any of Our Fans Furnished with Four Blades if so Ordered.

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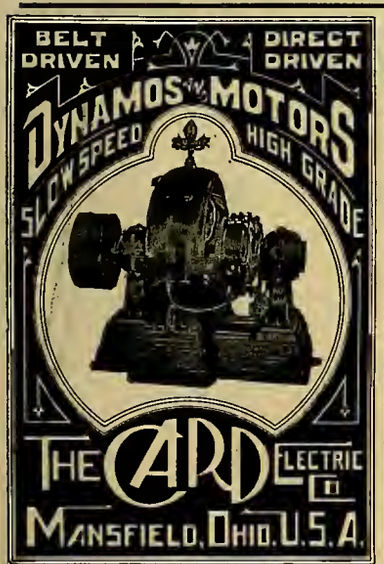
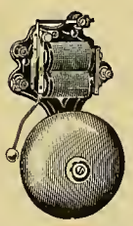
DIEHL MANUFACTURING CO.,

ELIZABETHPORT, N. J.

Agents for Canada: CANADIAN GENERAL ELECTRIC CO., 65-71 Front St. West, Toronto, Ont.



We have just issued a NEW catalogue of electrical books containing 100 pages, listing every work on electricity. A copy will be cheerfully mailed on receipt of a two-cent stamp.
ELECTRICIAN PUBLISHING CO.,
510 Marquette Bldg., Chicago.



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3 TO 15 INCHES.
ASK FOR IT.
SEND FOR CATALOGUE,
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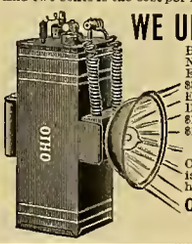
MANUFACTURERS,
290 Graham St., Brooklyn, N.Y.

It gives a light that's white and bright,
And two cents is the cost per night.



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Bicycle Electric Lights	$4.00
Necktie Electric Lights	1.50
Edison Electric Motors	1.00
$8 Medical Batteries	3.95
Electric Bells, finest	.25
Dry Batteries, best	.25
$100 Bicycles, best made	39.00
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Agents Wanted.
Our Bicycle Electric Light is the best thing that ever happened. Catalogue free.
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Generators, Motors, Transformers, for Two-Phase, Three-Phase and C. F. Scott Two-Phase Three-Phase System of Alternating Current Power Transmission.

26,000 H. P. IN OIL-INSULATED TRANSFORMERS CONSTRUCTED.

Potentials from 5,000 to 50,000 Volts. All Apparatus Necessary for 100 Mile Transmission.

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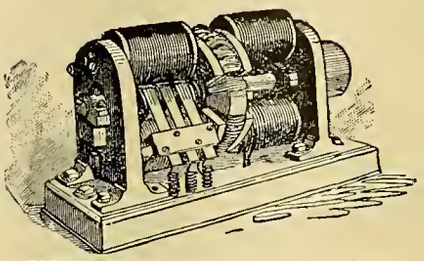
Chicago, N. Y. Life Bldg.
Philadelphia, Girard Bldg.
Pittsburg, Westinghouse Bldg.
St. Louis, American Central Bldg.
San Francisco, Mills Bldg.
Syracuse, N. Y., Bastable Bldg.
Tacoma, Wash., 102 S. 10th St.
Atlanta, Ga., Equitable Bldg.
Westinghouse Electric Co., Ltd.,
32 Victoria St., London, S. W., England.
For Canada address
Ahearn & Soper, Ottawa, Ont.

THE BRUSH ELECTRIC COMPANY.

BRUSH

THE BRUSH ELECTRIC COMPANY.

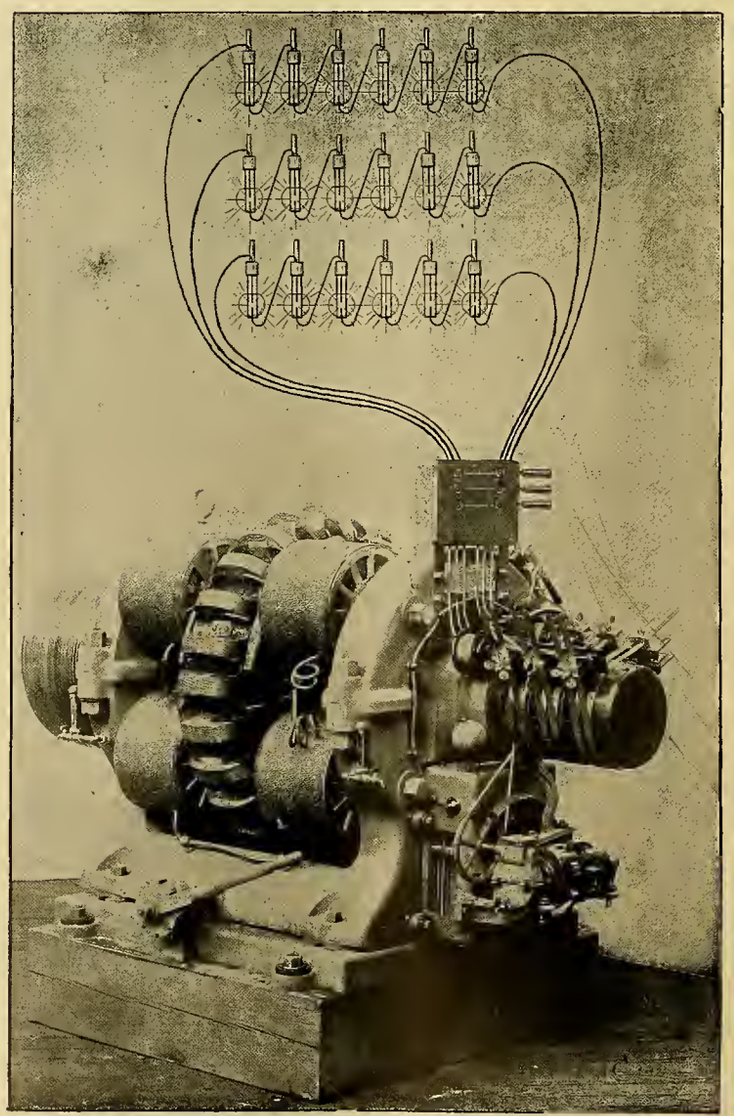
Brush apparatus has been on the market for 20 years. A majority of customers order supply parts direct from us. Many do not. We want this trade and are reducing our prices in order to secure it. Ask for quotations and send orders to the nearest Sales Office.



FIRST BRUSH ARC DYNAMO—1877

SALES OFFICES:
Schenectady, N. Y.
Cleveland, Ohio.
Boston, Mass., 180 Summer Street.
New York, N. Y., 44 Broad Street.
Philadelphia, Pa., 509 Arch Street.
Cincinnati, Ohio, 420 West Fourth Street.
Chicago, Ill., Monadnock Building.
St. Louis, Mo., Wainwright Building.
Atlanta, Ga., Equitable Building.
Denver, Colo., Kittredge Building.
San Francisco, Cal., 15 First Street.
Toronto, Ont., Canadian General Electric Co., Ltd.
Pittsburg, Pa., Carnegie Building.

Many stations have exchanged all their small units for large Brush arc dynamos. Among them are the Brooklyn-Citizens with 3000 lights capacity. Brooklyn-Municipal 800, Newark 3000, Cleveland 1800, Philadelphia Brush 1500, Philadelphia-Northern 1300, Buffalo 1500, Worcester 1400, Toronto 900, Quebec 625, Harrisburg 750, Erie 750, Albany 500, Troy 500, Paterson 500, City of Chicago 400, John Wanamaker 625, Carnegie Steel Co. 500.



BRUSH MULTI-CIRCUIT 125 LIGHT ARC DYNAMO—1897.

Over 40,000 lights capacity in large Brush arc dynamos sold. A large proportion of them using Multi-Circuit Dynamos.

The newly designed Brush dynamos have the following capacities; 55, 80, 100, 125, 240, 300, 2000 candle-power lights, 45, 85, 120, 160, 1200 candle-power lights.

Brush arc lamps were first used in 1877. More of them being sold to-day than ever before.

Two or more separate circuits run direct from one dynamo with any distribution of load on the different circuits. The advantages are absolute flexibility in handling of circuits; reduction of high voltages on circuits run from large dynamos; use of large units with corresponding increase of efficiency; saving in floor space, oil, belts, shafting, pulleys, attendance.

TRADE MARK:
"Chloride Accumulator"
REGISTERED SEPTEMBER 11, 1894.

CHLORIDE ACCUMULATORS

FOR

CENTRAL STATIONS, TROLLEY REGULATION,
ISOLATED LIGHTING AND POWER PLANTS, ETC.

CATALOGUES.

The Electric Storage Battery Co.,
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BRANCH OFFICES:
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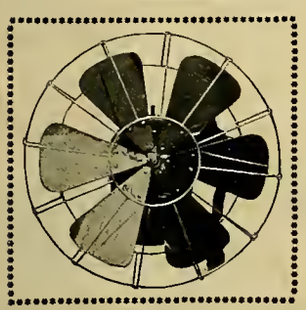

The Gem Water Motor Fan.

Novel in Construction. **Simple, Effective,**
As Easily Installed as an Electric Fan Motor. **Economical, Noiseless.**
Discounts for Exclusive Agents. Correspondence Solicited. List Price, $10.00.

JUST THE THING FOR SUPPLY HOUSES TO CARRY.

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McGILL & POMEROY, 1129 Monadnock, Chicago, Ill., Agents for Indiana, Illinois, Missouri, Iowa, Wisconsin, Michigan.

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QUALITY UNEQUALED
FACTORY PRODUCTION TRIPLED.

INCANDESCENT LAMPS.

Monadnock Building, Chicago. THE BUCKEYE ELECTRIC CO., Cleveland, Ohio.

FIVE GOOD BOOKS.

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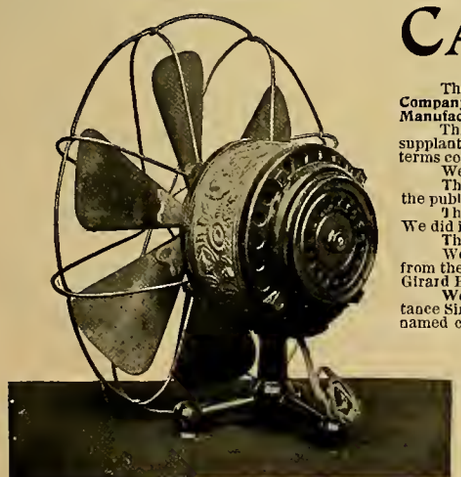
INCANDESCENT WIRING HAND-BOOK.
BELL HANGERS' HAND-BOOK.
ELECTRIC TRANSMISSION HAND-BOOK.
TELEPHONE HAND-BOOK.

ELECTRICIAN PUBLISHING CO., Suite 510 Marquette Building, CHICAGO, ILL.

ONE DOLLAR EACH.

CARD TO THE PUBLIC.



The **General Electric Company, Westinghouse Electric Company, Thomson-Houston Electric Company** and the **Tesla Electric Company** have brought suits against the **Scott & Janney Electric & Manufacturing Company** for "alleged infringements" of their various patents.

This is the **USUAL "BLUFF"** that is brought to bear upon those whose inventions are bound to supplant the inventions of the above named and other large electrical concerns, who cannot at their own terms control such new inventions.

We are manufacturing under **our own patents** and **are not infringing.**

The above named firms are suing us upon a small fan motor as an excuse to get a chance to make the public believe that the state of the art is not history as far as they know it.

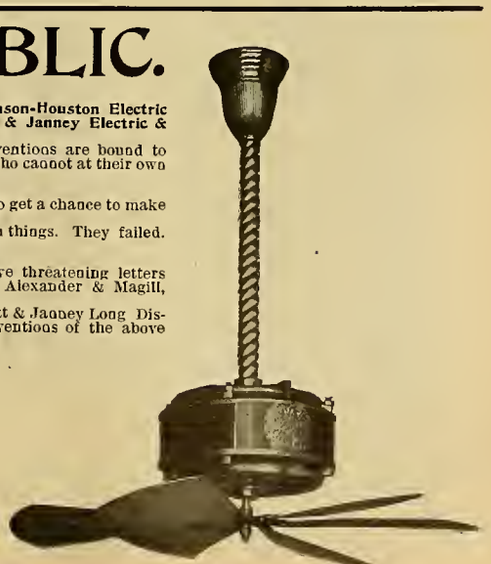
They have spent millions of dollars trying to invent apparatus to do certain things. They failed. We did invent it and have had it patented all over the world. **AND IT WORKS.**

They will try by strategy to do what they dare not do openly.

We wish to ask that the dealers and others who have received or will receive threatening letters from the above named concerns, will please send same to our attorneys, Messrs. Alexander & Magill, Girard Building, Philadelphia.

We are in the field to stay and do not propose to be intimidated. The Scott & Janney Long Distance Single Phase Alternating Railway and Power System will supersede the inventions of the above named companies. **AND THEY KNOW IT.**

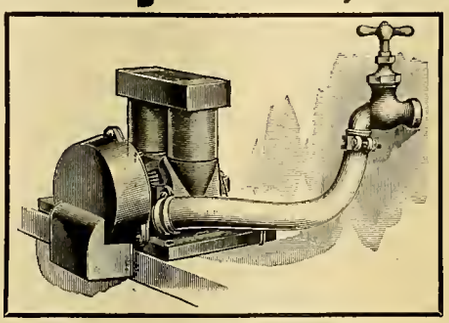
FULL PROTECTION GUARANTEED TO ALL PURCHASERS OF OUR APPARATUS.



The Scott & Janney Electric and Mfg. Co.,

1707-1709 Filbert Street, PHILADELPHIA.

Water Motor and Dynamo, Complete as shown, ready to attach to faucet, Price, $8.00



Weight, packed in box, 16 lbs.

Will charge storage batteries for bicycle lights and for medical apparatus.

Will light small incandescent lamps.

Direct current for general experimenting.

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Is guaranteed to prevent slipping and to preserve the leather.
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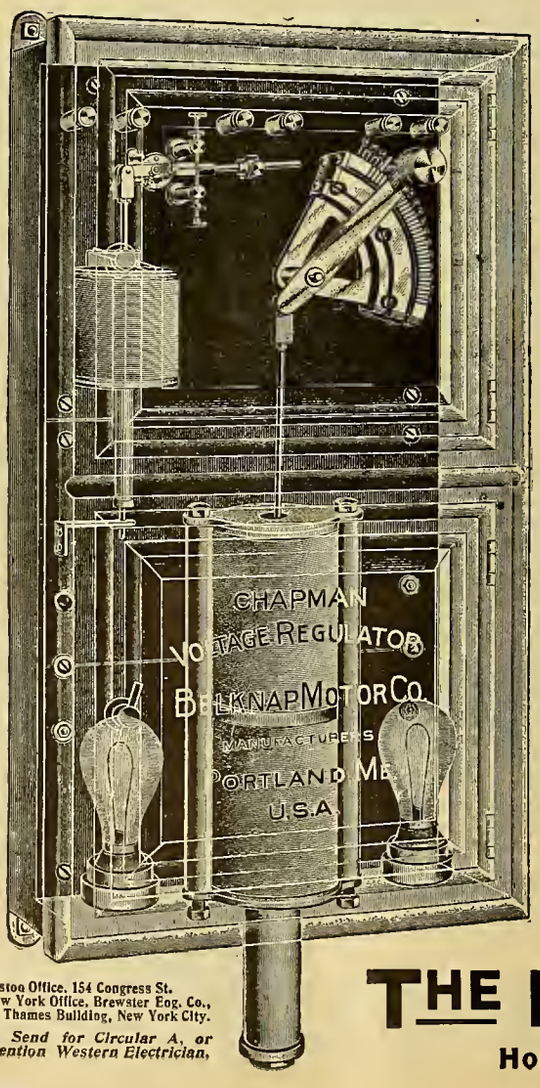
CHICAGO. **SUPPLIES**



Boston Office, 154 Congress St.
New York Office, Brewster Eng. Co., Thames Building, New York City.

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Steady Lights from Unsteady Power.

The Chapman Voltage Regulator

Controls the voltage of varying speed dynamos.

Lamp renewals reduced.

Perfect regulation of voltage by an automatic device magnetically controlled. 25 to 50 per cent. variation in speed of water wheel or engine controlled within 2 per cent. of the normal, and it acts as quick as a circuit breaker. Every central station should have them. Generators can be worked nearer the limit of their capacity by their use, thus increasing their effective working power.

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Glen Mfg. Co., Berlin, N. H.
Rumford Falls Sulphite Co., Rumford Falls, Me.
Northfield Electric Co., Northfield, Vt.
Hollingsworth & Whitney Co., Waterville, Me.
Bar Mills Electric Co., Bar Mills, Me.
Forest Mills Co., Bridgton, Me.
Norway Electric Light Co., Norway, Me.
Crookston Water, Pr. & Lt. Co., Crookston, Minn.
Pondicherry Mills, Bridgton, Me.
Kingston Electric Co., Philadelphia, Pa.
Burgess Sulphite Co., Berlin, N. H.
Cliff Paper Co., Niagara Falls, N. Y.
Westbrook Electric Light Co., Westbrook, Me.
Valleyfield Electric Co., Valleyfield, Quebec.
Orr & Co., Paper Mills, Troy, N. Y.

Recent orders have just been received from Stanley Electric Mfg. Co., Pittsfield, Mass.; Calumet & Hecla Smelting Co., So. Lake Linden, Mich.; Edison Elec. Ill'g Co., Topeka, Kan.; Marietta Elec. Co., Marietta, O., and Westbrook Elec. Lt. & Pr. Co., Westbrook, Me.

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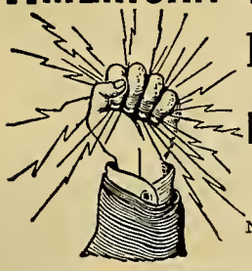
EUGENE F. PHILLIPS, Prest. F. N. PHILLIPS, Treas. W. H. SAWYER, Secy.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



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ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

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MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.

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FOR SWITCHBOARD, RAILWAY and MOTOR USE.

All sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

Inspector Boston Fire Underwriters' Union says:
"A thoroughly reliable and desirable wire in every respect."

The Clark wire has been before the public and in use for the past ten years, and has met with universal favor. We guarantee our insulation wherever used. Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first-class insulated wire. We shall be pleased to mail Catalogues, with terms and discounts for quantities.

EASTERN ELECTRIC CABLE COMPANY,

HENRY A. CLARK, Treas. and Gen'l Manager.
HERBERT H. EUSTIS, Pres. and Electrician.

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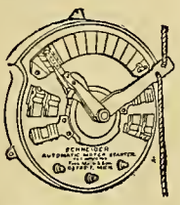

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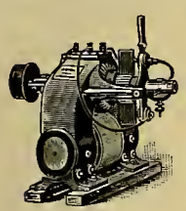

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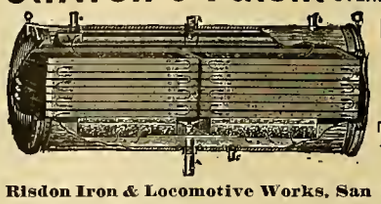

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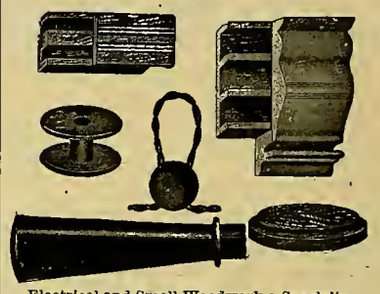

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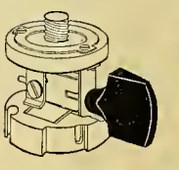

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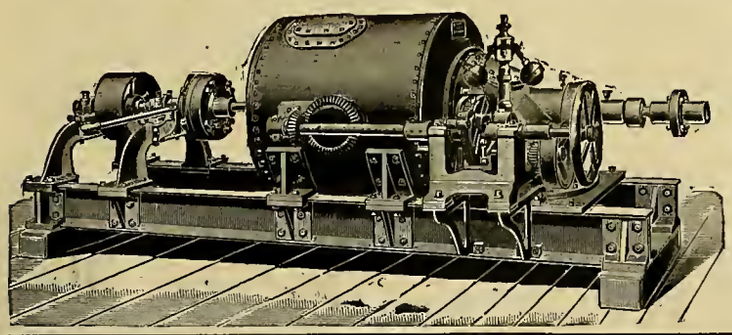

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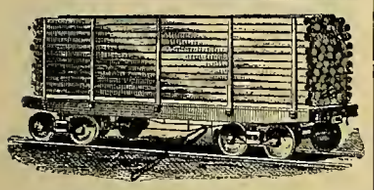

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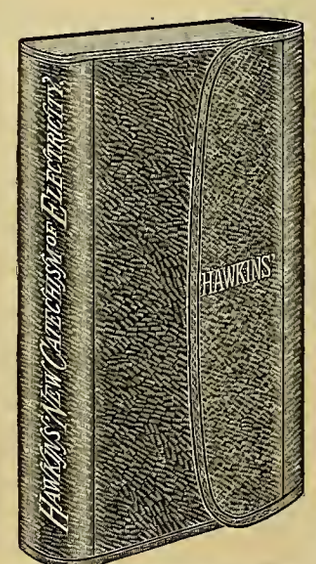

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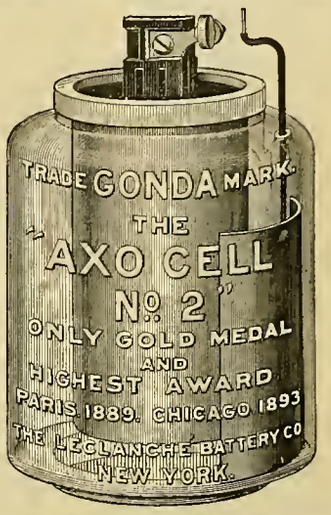

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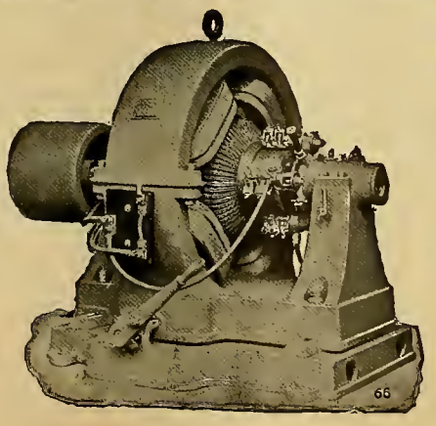

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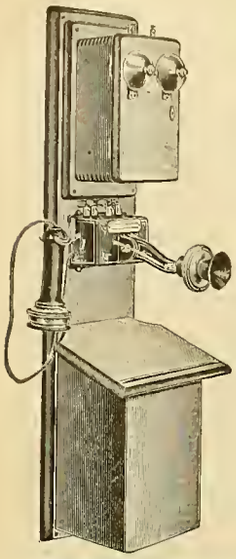

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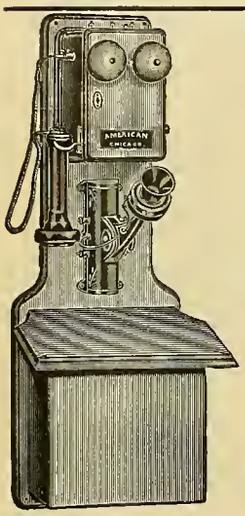

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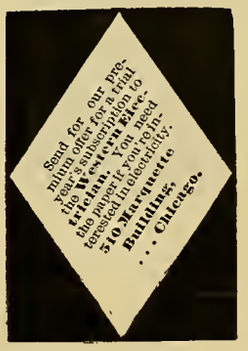

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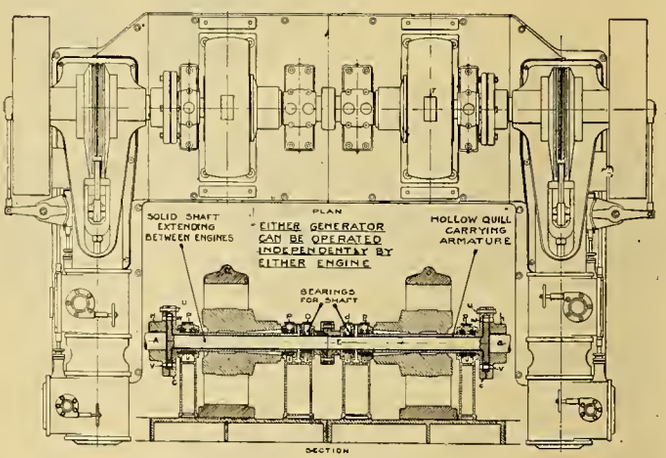

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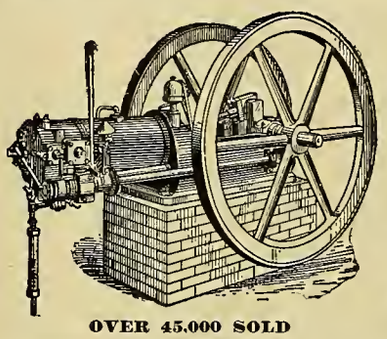

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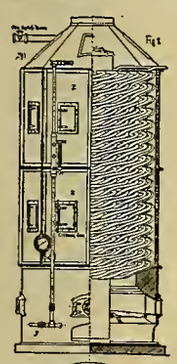

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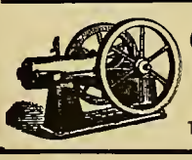

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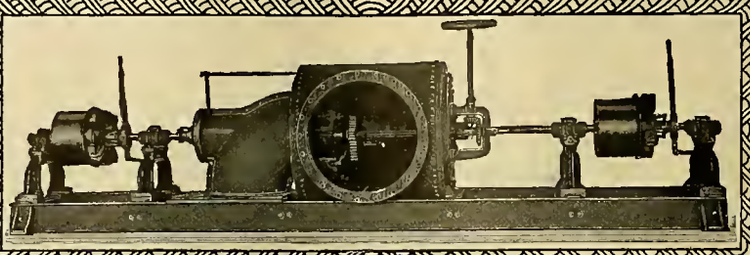

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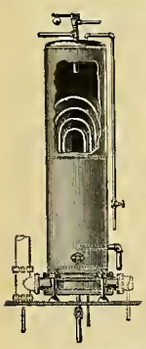

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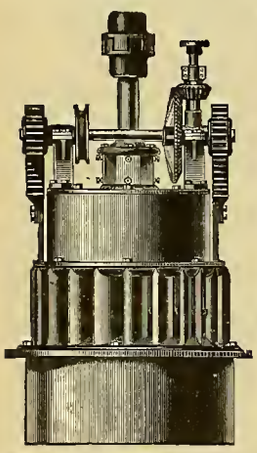

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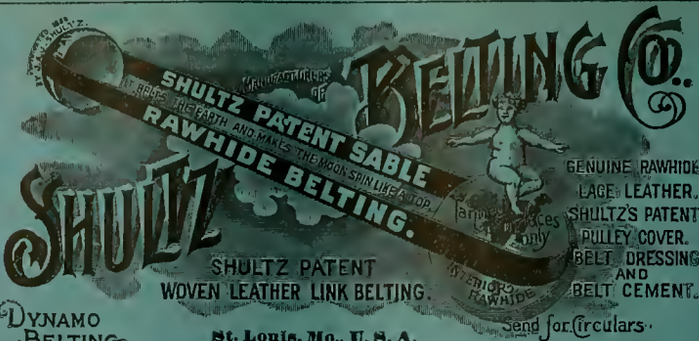

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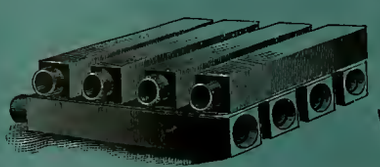
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Jewell Belting Co.,

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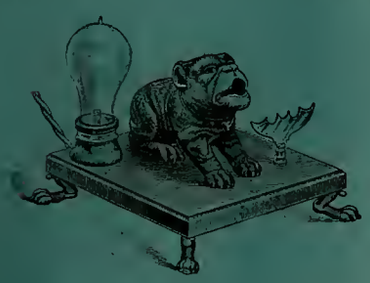
OAK BELTING LEATHER,

Manufacturers of....

High Grade Oak Belting,

HARTFORD, CONN.

Have You Seen Our Dog?



He is a great seller these hot days. He is easily kept, as he eats nothing but electricity, and only a little of that. He is not particular whether it is alternating or direct current, and he always repays the person who feeds him by heating up their curling iron to perfection.

Send for circular and prices.

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197 River Street, Detroit, Mich.

WESTON Electrical Instrument Co.,

114-120 William St., NEWARK, N. J., U. S. A.

The Weston Arc Light Ammeter

Is cheap, but nevertheless reliable and very accurate.

The scale is so proportioned that a change of $\frac{1}{10}$ of one ampere can be seen from a considerable distance. The instrument is absolutely "dead beat." Three different ranges are being made:

No. 1.	5.8	6.8	7.8	amperes in	$\frac{1}{10}$ ampere div.
No. 2.	8.6	9.6	10.6	" "	$\frac{1}{10}$ " "
No. 3.	9.5	10.5	11.5	" "	$\frac{1}{10}$ " "

HIGHEST AWARDS

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INSULATED WIRES AND CABLES.

AERIAL, UNDERGROUND, SUBMARINE.

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PLATINUM

For all Purposes.

Scrap and Native Platinum Purchased.

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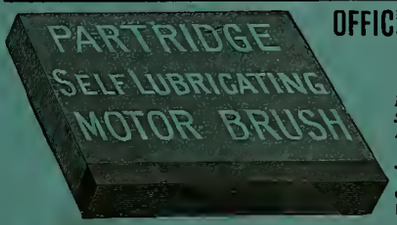

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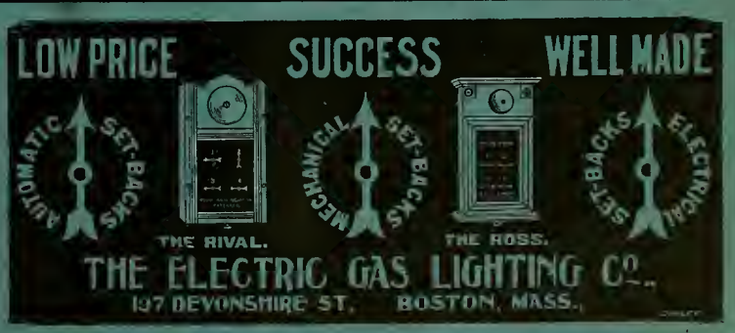
Smith & Wallace, Hamilton St., Boston, Mass.
Arthur S. Partridge, Bank of Commerce Bldg., St. Louis, Mo.
Joshua Hendy Machine Works, 42 Fremont St., San Francisco.
Central Electric Co., 173 Adams St., Chicago.
Harry M. Shaw, 120 Liberty St., New York.
Schmiake & Newman, New Orleans, La.



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But can't spare the money." To such we say—let us know how much you can pay in cash—give us references, and we will take balance in installments.

HAVE YOU TRIED

EUREKA PACKING? It lasts 3 to 4 times longer than any other. We manufacture Feed Water Heaters, Damper Regulators, Separators, Oil Extractors, Exhaust Heads, Filters, Etc.

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Successors to HINE & ROBERTSON CO.

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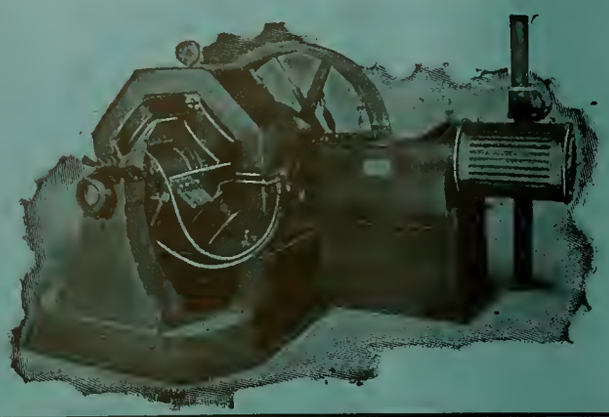
Direct Connected or Belted for Electric Railways, Central Stations, Isolated Lighting or Power Plants.



Eddy Motors—Slow, Medium or High Speed.

We build all necessary apparatus for the transmission of Electrical Power through factory or other buildings.

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Alcatraz Electrical Compound,

Manufactured by

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ABSOLUTELY UNEQUALED FOR

ELECTRICAL AND WIRE INSULATION, Insulating Connections, Dynamos and Motor Bases, Battery and Accumulator Shelving, Circuit and Switch-Boards.
WATER-PROOFING Cut-Out Boxes, coating wires when subjected to acid or alkaline fumes, and when laid under cement, etc.
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ALCATRAZ ELECTRICAL COMPOUND is manufactured of the celebrated brand of Alcatraz Asphalt, and possesses many well-known points of superiority. It has been tried under severe and exacting conditions, and has given perfect satisfaction. **It will not Scale, Crack or Burn. Presents a Smooth Surface. Adheres Tenaciously. Not affected by Thermal or Climatic Conditions. Resists the action of the Elements, Acids, Alkalies, Sewer Gases, and possesses great strength and elasticity.** Being the producers of the raw product, we are enabled to save the middleman's profit, and offer consumers a superior article at a very low price. **SAMPLE UPON APPLICATION. Agents wanted in all leading cities.**

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GUARANTEED TO OPERATE PERFECTLY OR NO PAY. MADE FOR ALTERNATING OR DIRECT CURRENT. ANY VOLTAGE. CATALOGUE FREE.

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Simple in Construction.

Successfully Stood the Severe Tests of Last Winter's Snowstorms.

Practical in Operation.

SEND FOR FULL PARTICULARS.

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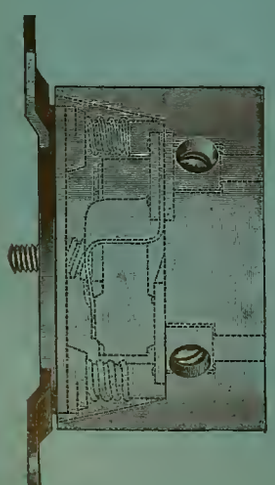

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This is One Way of Putting Up

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AND NO EXTRA COST.

All Parts of Switch Insulated. Solid Adjustable Plates Any Size You Want.

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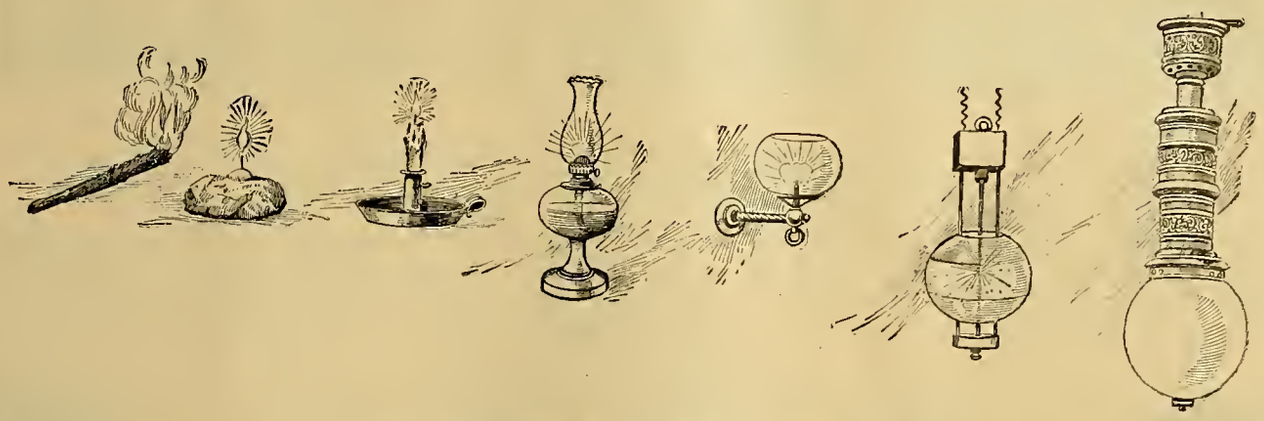

From the Torch to the "PIONEER" Enclosed Arc Light, the world has gradually advanced through all the stages of improving illumination until now we are practically delivering artificial sunshine. Steady, Clear, Soft, Shadowless, Simple, Economical and Safe.

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LOUIS B. MARKS, M. M. E., CHIEF ELECTRICIAN.

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PIONEERS IN ENCLOSED ARC LIGHTING — THE PIONEER — TRADE MARK

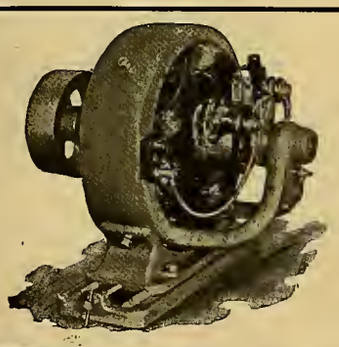
150 HOURS.

YOUR SUPPLY MAINTAINED FOR 12c.

LAMPS Efficient, Long-Lived and Guaranteed Satisfactory.

Write us before making another contract. We are THE Lamp Renewing Company you have heard of.

Lynn Incandescent Lamp Co., Lynn, Mass.



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DYNAMOS,

15 to 1,000 Lights.

MOTORS,

½ to 50 H. P. ANY VOLTAGE.

Patented Adjustable Dynamos and Motors for Floor, Wall or Ceiling.

The Ahlm-Edwards Electric Co.,

CLEVELAND, OHIO.

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Multipolar Motors AND Generators

FOR

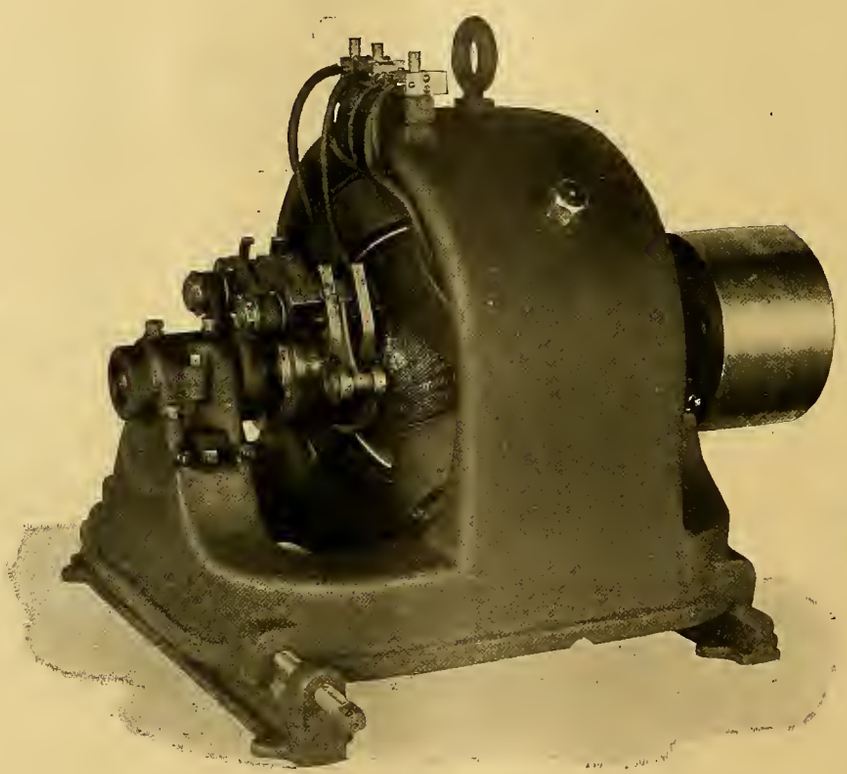
DIRECT CURRENT.

Cast Steel Pole Piece.

A New Design,

Embodying Every Advantageous Feature desired in this Form of Apparatus.

Self-aligning Bearing.



Sparkless Commutation.
Highest Efficiency.
Slow Speed or Moderate Speed as Desired.
Minimum Heating.
Minimum Attention in Operation.
Perfect Commutator.
Self-Lubricating Carbon Brushes.
Best Materials.
Fine Appearance.

Ready for Delivery.

Motors

For 110, 250 or 500 Volts.
SLOW SPEED—1 to 15 H. P.
Moderate Speed—1.5 to 20 H. P.

Generators.

For 110, 250 or 500 Volts.
Slow Speed—1 to 12.5 k. w.
Moderate Speed—1.5 to 16 k. w.

A Series Coil.

REMEMBER

That it is easy to design and build motors and generators that will run, but when efficiency, durability, first-class machine work and perfect operation are called for, but few machines are worth considering seriously.

Standard Shunt Field Coil.

Wagner Electric Mfg. Co.

SELF-STARTING SINGLE PHASE, Non-Synchronous Alternating Current Power Motors,
Transformers. Switchboards. Switchboard Instruments. Ceiling Fan Motors.

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409 Market St., San Francisco.
W. A. Johnson Electric Co., Toronto.
Central Electric Co., Chicago.

We are after your Fan Motor Business,

AND WANT IT.

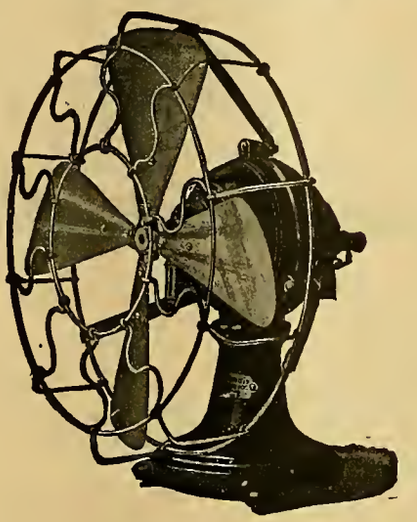
The backward season finds us at pre-inventory time overstocked on

Lundell Fan Montors;

we want them to move out of our hands rapidly, and create a refreshing breeze for you, and to that end we are offering them at

Greatly Reduced Prices.

These are not single season motors; are built for this year, next



year, and years after that—are good to have on hand ready for a hot day; you can do twice as much work with four times the comfort, can get two nights' sleep in one, and defy the eccentricities of the weather man if you have one of these busy, breezy motors distributing refrigerated imitations of lake breezes. We have them in two sizes, 12 inch and 16 inch. Telephone us, telegraph us, or send for our circular.

CENTRAL ELECTRIC COMPANY,

Geo. A. McKinlock, Prest.
Charles E. Brown, Sec'y.
S. R. Frazier, Treas.

173=175 Adams Street,
CHICAGO.

OKONITE
IT NEVER DISAPPOINTS

The Crocker-Wheeler Electric Company

Have pleasure in announcing that they are established at

Rooms 1514=16 Old Colony Building, Chicago,

For the conduct of their business as manufacturers and electrical engineers formerly conducted in this territory by Messrs. Sargent and Lundy. Mr. C. H. Wilmerding as Western manager, Mr. T. M. Pedersen of the factory as engineer, and Mr. Julian Roe as salesman, have been detailed to this office and a tried and competent construction force is employed. Customers will have, in consequence, the advantage of dealing with the company, and of obtaining direct the benefit of its well-known guarantees and its engineering ability, and will have the convenience of direct telegraphic communication with the factory at Ampere, N. J. Telephone Harrison 33.

PARAGON
FAN MOTORS.
CHICAGO EDISON COMPANY,
139 ADAMS STREET, CHICAGO.

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Huebel & Manger.
Ohio Electric Works.
Partrick & Carter Co.

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Main Belting Co.
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Shultz Belting Co.

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Books. Electrical.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Commercial El. Supply Co.
Holmes Fibre-Graphite Co.
Partridge Carbon Co.

Burglar Alarms.
Central Electric Co.
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Huebel & Manger.
Partrick & Carter Co.

Cables (See Insulated Wires.)
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General Electric Co.
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Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

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Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
Gen'l Inc. Arc Light Co.
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Cars.
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Central Electric Co.
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Standard Paint Co.

Conduits.
Armorite Interior Cond. Co.
Central Electric Co.
Commercial El. Supply Co.
Conn. Pipe Mfg Co.
Electric Appliance Co.
Muir & Son, Thos.
Williamsport Wdn. Pipe Co.

Construction & Repairs.
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Hodge, Walsh & Loring.
Warren Electric Mfg. Co.

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Ahlm-Edwards El. Co.
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Card Electric Co.
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General Electric Co.
Metropolitan Electric Co.
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Cordage.
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Commercial El. Supply Co.
Electric Appliance Co.

Cut-Outs and Switches.
Automatic Clr. Breaker Co.
Bryant Electric Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
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Eddy Elec. Mfg. Co.
Electrical Supply Co.
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Ft. Wayne Elec. Corporation.
General Elec. Co.
Hart & Hegeman Mfg. Co.
Paiste Co., H. T.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Perkins Elec. Switch Mfg. Co.
Reynolds, S. K.
Wagner Elec. Mfg. Co.
Westinghouse El. & Mfg. Co.

Dynamos.
Ahlm-Edwards El. Co.
American Engine Co.
Brush Electric Co.
Bullock Elec. Mfg. Co.
Card Electric Co.
Central Electric Co.
Commercial El. Supply Co.
Crocker-Wheeler Elec. Co.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Muir & Son, Thos.
Northern Electl. Mfg. Co.
Scott & Janney El. & Mfg. Co.
Siemens & Halske Elec. Co.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Fuel Economizer Co.

Electric Heaters.
American El. Heater Co.
American El. Heating Corp.
Central Electric Co.
Johns, H. W., Mfg. Co.

Electric Meters.
American El. Meter Co.
Central Electric Co.

Electric Railways.
Brush Electric Co.
General Electric Co.
Krotz, Allen & Kelly.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Bain, Forse.
Bryan & Humphrey.
Pratt, Chas. A.

Electrical Instruments.
Automatic Clr. Breaker Co.
Central Electric Co.
Commercial El. Supply Co.
Cutter El. & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Keystone El. Instrument Co.
Paiste Co., H. T.
Queen & Co.
Weston Electrical Inst. Co.

Electrical Specialties.
Automatic Clr. Breaker Co.
Central Electric Co.
Commercial El. Supply Co.
Metropolitan Electric Co.
Paiste Co., H. T.
Peru Elec. Mfg. Co.
Vought, M. I.

Electrical Woodwork.
Lever, C. H. Mfg. Co.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
General Electric Co.

Engines, Gas.
Case, J. I., T. M. Co.
Otto Gas Engine Wks.
Van Duzen Gas & Gas. En. Co.
Van Horne, Burger & Co.

Engines, Steam.
American Engine Co.
Ball Engine Co.

Fan Outfits.
Central Electric Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
General Electric Co.
Hunter Fan & Motor Co.
Schneider Mfg. Co.
Scott & Janney El. & Mfg. Co.
Wagner Electric Mfg. Co.
Western Elec. Co.
Westinghouse El. & Mfg. Co.

Feed Water Heaters.
Davis & Son, I. B.

Fibre.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.
Central Electric Co.

Fixtures, El. & Comb'n.
Central Electric Co.
Commercial El. Supply Co.

Fuses.
D. & W. Fuse Co.

Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
Commercial El. Supply Co.
Electric Appliance Co.

Gaskets.
Johns, H. W., Mfg. Co.
Peerless Rubber Mfg. Co.

Gas Lighting, Electric.
Central Electric Co.

Gears.
Besly & Co., Chas. H.
Central Electric Co.

General Elec. Supplies.
Besly & Co., Chas. H.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
Electrical Supply Co.
General Electric Co.
Genor & Colburn.
Hodge, Walsh & Loring.
International Elec. Co.
Metropolitan Electric Co
Ohio Electric Works.
Paiste Co., H. T.
Partrick & Carter Co.
Peoples Electric Co.
Peru Elec. Mfg. Co.

Globes and Electrical Glassware.
Central Electric Co.
Commercial El. Supply Co.

Gov'nors, Water Wheel.
Lombard Water Wheel Gv. Co.

Graphite Specialties.
Besly & Co., Chas. H.
Central Electric Co.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Induction Coils.
Central Electric Co.
International Elec. Co.
Queen & Co.

Insulators and Insulating Materials.
Brixey, W. R.
Bryant Electric Co.
California Asphalt Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
Electrical Supply Co.
Empire China Works.
Hodge, Walsh & Loring.
Johns Mfg. Co., H. W.
Mica Insulator Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Paiste Co., H. T.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Phillips Insulated Wire Co.
Standard Paint Co.
Simplex Electrical Co.
Standard Underground C. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

Lamp Adjusters.
Vought, M. I.

Lamps, Incandescent.
Buckeye Electric Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
General Electric Co.,
Lynn Incandescent Lp. Co.
Metropolitan Electric Co.
Ohio Electric Works.
Perkins Elec. Switch Mfg. Co.
Sawyer-Man Elec. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamp Trim'r's Wagons.
Studebaker Bros. Mfg. Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Westinghouse El. & Mfg. Co.

Magnet Wire.
(See Insulated Wires.)

Mechanical Machinery.
Besly & Co., Chas. H.
Garvin Machine Co., The.
Robertson & Sons, Jas. L.
Stilwell-Bierce Smith-Vaile

Mica.
Central Electric Co.
Commercial El. Supply Co.
McLaurin & McLaren.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
General Electric Co.
Westinghouse El. & Mfg. Co.

Motors.
Ahlm-Edwards Elec. Co.
American Engine Co.
Belknap Motor Co.
Brush Electric Co.
Bullock Elec. Mfg. Co.
Card Electric Co.
Central Electric Co.
Commercial El. Supply Co.
Crocker-Wheeler Elec. Co.
Dallett & Co., Thos. H.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Electrical Supply Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Metropolitan Electric Co.
Muir & Son, Thos.
Northern Electl. Mfg. Co.
Ohio Electric Works.
Peoples Electric Co.
Scott & Janney El. & Mfg. Co.
Stanley Elec. Mfg. Co.
Storey Motor & Tool Co.
Triumph Electric Co.
Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co

Packing.
Besly & Co. Chas. H.
Garlock Packing Co.
Johns, H. W., Mfg. Co.
Pearlesa Rubber Mfg. Co.
Robertson & Sons, Jas. L.

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California Asphalt Co.
Central Electric Co.
Commercial El. Supply Co.
Johns, H. W. Mfg. Co.
Standard Paint Co.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co. Ltd.

Platinum.
Baker & Co.

Poles.
Carley, Ira.
Lindsley Bros.
National Tube Works Co.
Perrizo & Sons.
Sterling & Son, W. C.

Porcelain.
Bryant Electric Co.
Central Electric Co.
Commercial El. Supply Co.
Empire China Works.
Peru Elec. Mfg. Co.

Push Buttons.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Partrick & Carter Co.

Refiners.
Swarts Metal Refining Co.

Reflectors.
Muir & Son, Thos.

Regulators.
Belknap Motor Co.

Re-Winding.
Central Electric Co.
Chicago Edison Co.
Electrical Exchange, The.
Hodge, Walsh & Loring.

Rheostats.
Am. El. Heat. Corporation.
Central Electric Co.
General Electric Co.
Iron Clad Rheostat Co.
Leonard, Ward, Elec. Co.
Muir & Son, Thos.
Westinghouse El. & Mfg. Co

Second-Hand Machin'y.
Cornman Co.
Electrical Exchange, The.

Shades.
Central Electric Co.
Muir & Son, Thos.

Speaking Tubes.
Central Electric Co.
Electric Appliance Co.
Partrick & Carter Co.

Speed Indicators.
Besly & Co., Chas. H.
Central Electric Co.
Keystone El. Instrument Co.
Queen & Co.
Weston Electrical Inst. Co.

Steel Pipe.
National Tube Works Co.

Storage Batteries.
American Battery Co.
Central Electric Co.
Electric Storage Battery Co.
Ohio Storage Battery Co.
Willard El. & Battery Co.

Tapes, Insulating.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co
Okonite Co., The.
Simplex Electrical Co.
Standard Paint Co.
Washburn & Moen Mfg. Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Commercial El. Supply Co.
Kusel, D. A., Tel. Mfg. Co.
Lockwood T. & T. Co. of Am.
Metropolitan Electric Co.
Orna Elec. Cons. Co.
Peoples Electric Co.
Standard Tel. & El. Co.
Stromberg-Carlson Tl. M. Co.
Taber & Mayer.
Viaduct Mfg. Co.
Western Tel. Cons. Co.
Whitman & Couch.

Transformers.
Central Electric Co.
Commercial El. Supply Co.
Diamond Elec. Co.
Ft. Wayne Elec. Corporation
General Electric Co.
Stanley Electric Mfg. Co.
Wagner Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

Trolley Cord.
Central Electric Co.
Samson Cordage Wks.

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Brill Co., J. G.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Water Wheels.
Am. Impulse Wheel Co.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

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Besly & Co., Chas. H.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co
Standard Underground C Co
Washburn & Moen Mfg. Co.

X Ray Outfits.
Central Electric Co.
Commercial El. Supply Co.
Queen & Co.

For Alphabetical Index of Advertisements See Page III.

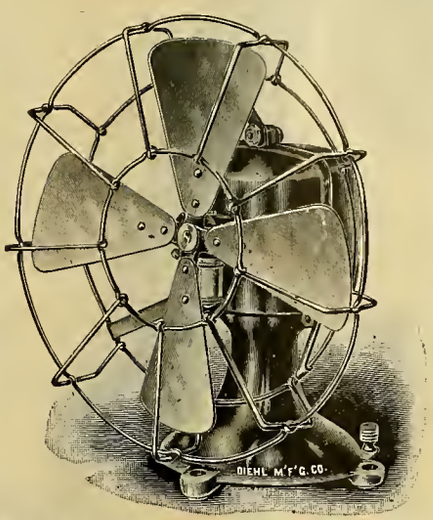
DIEHL ELECTRIC FANS.

Ceiling Fans and Exhaust Wheels

Wound for Any Current, Except Alternating.

Our Exhaust Wheel Combinations

Are the most compact and efficient made.
Write for catalogue and prices.



Propeller or Desk Fans

Wound for 110, 220 or in series on 500 volts.
Also for Primary or Secondary Battery Circuits.

Highest Efficiency

Unbroken Magnetic Circuit, Self-Aligning Bronze Bearings. Finest Insulation Throughout. Four-Speed Regulator.

SHOW ROOMS: New York, 561-563 Broadway; Chicago, 192-194 Van Buren St.; Boston, 128-132 Essex St.

DIEHL MANUFACTURING CO., ELIZABETHPORT, NEW JERSEY.

Agents for Canada: Canadian General Electric Co., Toronto, Ontario.

A NON-ARCING FUSE.

A RELIABLE AND ACCURATE FUSE.

A FUSE that will open a High-Tension Short Circuit without **ARC OR FLASH.**
Endorsed by the National Board of Underwriters.

53 Aborn St. **D. & W. FUSE CO.,** Providence, R. I.

FUSE WIRE AND LINKS FOR ALL SYSTEMS. Correct Carrying Capacity. Absolutely Uniform.

CHICAGO FUSE WIRE & MFG. CO.,
153 Lake St., Chicago.

Westinghouse Polyphase Apparatus Supreme.

Generators, Motors, Transformers, for Two-Phase, Three-Phase and C. F. Scott Two-Phase Three-Phase System of Alternating Current Power Transmission.

26,000 H. P. IN OIL-INSULATED TRANSFORMERS CONSTRUCTED.

Potentials from 5,000 to 50,000 Volts. All Apparatus Necessary for 100 Mile Transmission.

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Chicago, N. Y. Life Bldg.
Philadelphia, Girard Bldg.
Pittsburg, Westinghouse Bldg.
St. Louis, American Central Bldg.
San Francisco, Mills Bldg.
Syracuse, N. Y., Bastable Bldg.
Tacoma, Wash., 102 S. 10th St.
Atlanta, Ga., Equitable Bldg.
Westinghouse Electric Co., Ltd., 32 Victoria St., London, S. W., England.
For Canada address Ahearn & Soper, Ottawa, Ont.

AD STUDIO
COMMERCIAL
ELECTRICAL
SUPPLY
CO.,
ST. LOUIS.

"Clarence"

(Fond of music and flowers and a new-comer in the electrical business),

As you will note, is determined he will post himself on the best, most varied and extensive stock of electrical supplies in the United States—so he studies

Our New Catalogue!

Send
for
One—
the Catalogue,
not Clarence!

We beg to advise you that we have several catalogues—but only one Clarence!

P. S.—Say, honest, ain't he a "beaut?"

"THE ELECTRA"

ELECTRA ·TRADE MARK·

HIGHEST GRADE NUERNBERG CARBONS.

FOR DIRECT CURRENT ARC LAMPS. FOR ALTERNATING CURRENT ARC LAMPS.

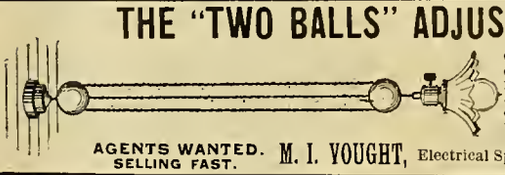
SEND FOR LATEST PRICE LIST TO

HUGO REISINGER, NO. 38 BEAVER STREET, NEW YORK. SOLE IMPORTER FOR THE UNITED STATES AND CANADA.

STORAGE BATTERIES.

INEXPENSIVE, DURABLE, LIGHT.
See Advertisements in Electric Light Convention Issues.
THE OHIO STORAGE BATTERY CO., 59 Wade Bldg., Cleveland, O.

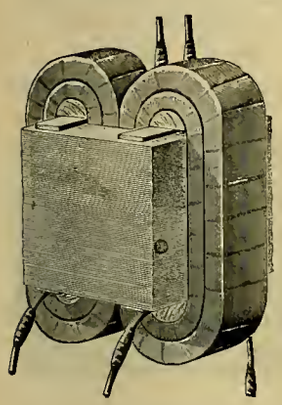
THE "TWO BALLS" ADJUSTABLE HANGER



Can be used in connection with common rosette, or an attachment plug, the lamp remaining at any desired height. You can have the light exactly where you want it.

AGENTS WANTED. SELLING FAST. M. I. VOUGHT, Electrical Specialties, 202 South Front St., LA CROSSE, WIS.

Transformers (SCHEEFFER'S IMPROVED) Wattmeters.

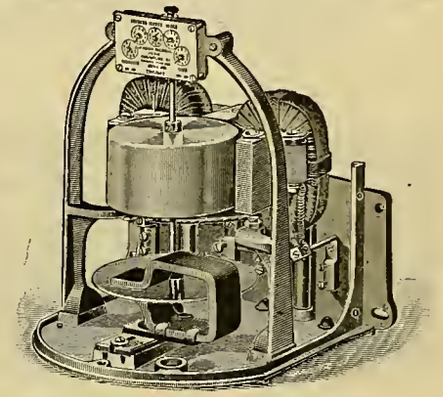


Double Primary Coils,
Double Secondary Coils,
Good Ventilation,
Light Weight,
High Efficiency,
Good Regulation,
Small Iron Loss.

Convenient to Install.

No Brushes,
No Commutator,
No Moving Wire,
Simplicity,
Durability,
Reliability,
Accuracy,

Even to a 6 c. p. Light.



DIAMOND ELECTRIC CO.,
Manufacturers,

Office: 1202 Fisher Bldg., CHICAGO, ILL.

Factory: PEORIA, ILL.

The Tuerk Alternating Current Ceiling Fan.

1897 PATTERNS NOW READY.

Some New Features Embodied in Our '97 Product Make it Better than Ever.

MADE FOR FROM 50 TO 120 VOLTS.
60, 125 AND 140 CYCLES.

SPECIAL FEATURES:
High Economy.
Self-Oiling Bearings.
Adjustable Blades.
Starting Switch at Bottom.

Five different styles of finish—Bronze, Bower-Barff, Ivory and Gold, Nickel, Polished Brass.

THE HANDSOMEST FAN ON THE MARKET.

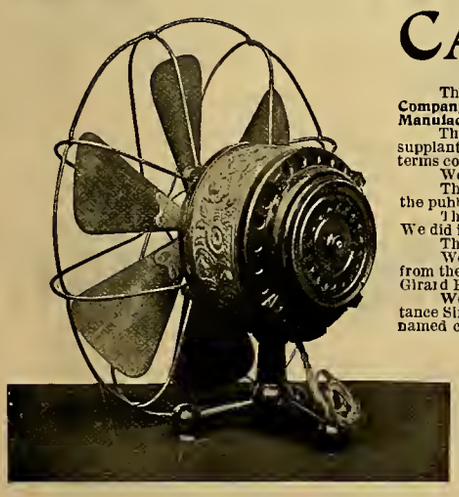
Strong, Reliable, Noiseless, Durable, Ornamental and Inexpensive to Operate.

SEND FOR 1897 CATALOGUE.

HUNTER FAN & MOTOR CO.,
FULTON, NEW YORK.

E. B. LATHAM & CO., General Selling Agents, 136 Liberty Street, New York, U. S. A.

CARD TO THE PUBLIC.



The **General Electric Company, Westinghouse Electric Company, Thomson-Houston Electric Company** and the **Tesla Electric Company** have brought suits against the **Scott & Janney Electric & Manufacturing Company** for "alleged infringements" of their various patents.

This is the **USUAL "BLUFF"** that is brought to bear upon those whose inventions are bound to supplant the inventions of the above named and other large electrical concerns, who cannot at their own terms control such new inventions.

We are manufacturing under **our own patents and are not infringing.**

The above named firms are suing us upon a small fan motor as an excuse to get a chance to make the public believe that the state of the art is not history as far as they know it.

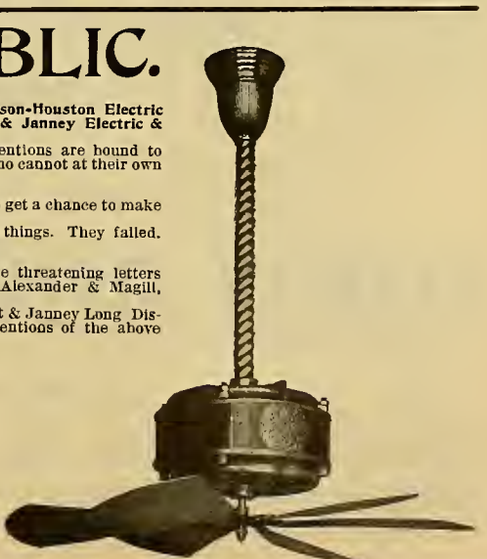
They have spent millions of dollars trying to invent apparatus to do certain things. They failed. We did invent it and have had it patented all over the world. **AND IT WORKS.**

They will try by strategy to do what they dare not do openly.

We wish to ask that the dealers and others who have received or will receive threatening letters from the above named concerns, will please send same to our attorneys, Messrs. Alexander & Magill, Girard Building, Philadelphia.

We are in the field to stay and do not propose to be intimidated. The Scott & Janney Long Distance Single Phase Alternating Railway and Power System will supersede the inventions of the above named companies. **AND THEY KNOW IT.**

FULL PROTECTION GUARANTEED TO ALL PURCHASERS OF OUR APPARATUS.



The Scott & Janney Electric and Mfg. Co.,

1707-1709 Filbert Street, PHILADELPHIA.

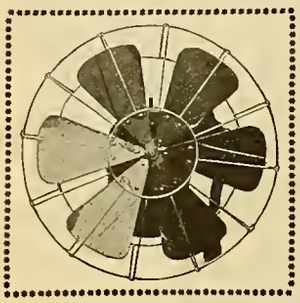
THE OLD, ORIGINAL **SAWYER-MAN LAMP**

Is Still Made and Sold by Us.

SAWYER-MAN ELECTRIC CO.,

125 Robinson St., Allegheny City, Pa.

New York, 510 West 23d St.



The Gem Water Motor Fan.

Novel in Construction. **Simple, Effective,**
As Easily Installed as an Electric Fan Motor. **Economical, Noiseless.**
Discounts for Exclusive Agents. Correspondence Solicited. List Price, $10.00.

JUST THE THING FOR SUPPLY HOUSES TO CARRY.

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McGILL & POMEROY, 1129 Monadnock, Chicago, Ill., Agents for Indiana, Illinois, Missouri, Iowa, Wisconsin, Michigan.

WESTERN ELECTRIC CO.

CHICAGO. **SUPPLIES**

THE S. K. C. SYSTEM.

A COMPLETE SYSTEM FOR

Long Distance Transmission,
General Station Distribution,
Mill and Factory Equipment.

Generators will be wound and guaranteed for an E. M. F. as high as

10,000 VOLTS.

CORRESPONDENCE SOLICITED

STANLEY ELECTRIC MANUFACTURING COMPANY,

Pittsfield, Mass., U. S. A.

THE ROYAL ELECTRIC CO., Montreal, Canada, are sole licensees for the manufacture and sale of the S. K. C. System in Canada. . . . . .

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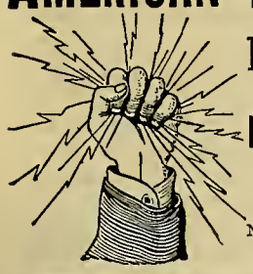
EUGENE F. PHILLIPS, Prest. F. N. PHILLIPS, Treas. W. H. SAWYER, Secy.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



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ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

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THE ONLY
WATER-WHEEL GOVERNOR
THAT GOVERNS.

WATERVILLE & FAIRFIELD RAILWAY & LIGHT CO.,
WATERVILLE, ME., Jan. 18, 1896.

Lombard Water-Wheel Governor Co., Boston, Mass.

GENTLEMEN:—In regard to your Type C governor, which is regulating for us our two Hercules Wheels, which give power to operate our Light Plant, Street R. R. and Power Generator, we are frank to admit that the machine does its work admirably. We have no hesitancy in recommending it to those in want of a governor.

(Signed)
I. C. LIBBY, President Waterville & Fairfield R. R. & L. Co.

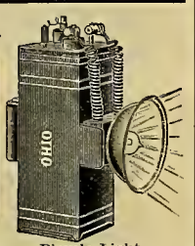
LOMBARD WATER-WHEEL GOVERNOR CO.,
61 Hampshire St., BOSTON, MASS.

The 4 Leading Electric Novelties. We undersell all on Everything Electrical.

Necktie Light.

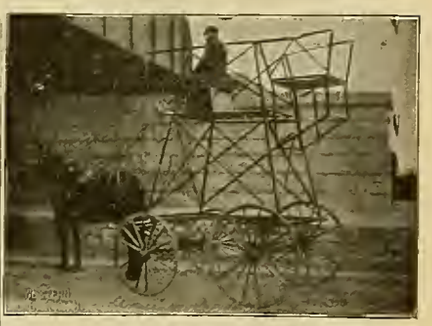
Dollar Motor.

$3 Necktie Light.



Bicycle Light.

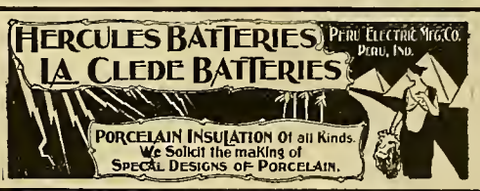
OHIO ELECTRIC WORKS, CLEVELAND, O.
Agents wanted. Headquarters for Electric Novelties. Catalogue free. Our $6 Fan Motor with 4 Batteries equals any $30 Outfit.



TRIMMER'S TOWER WAGON.
NOVEL FEATURES.

With it a Trimmer can trim about 250 lamps as compared with 60 lamps trimmed by "trudging with ladder and kit." Write for detailed description.

STUDEBAKER BROS. MFG. CO.,
SOUTH BEND, IND.



GORDON PRIMARY CELL.
For Open and Closed Circuit Work.

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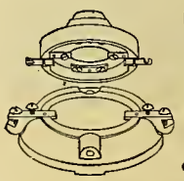

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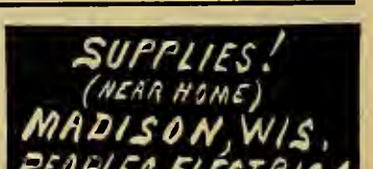

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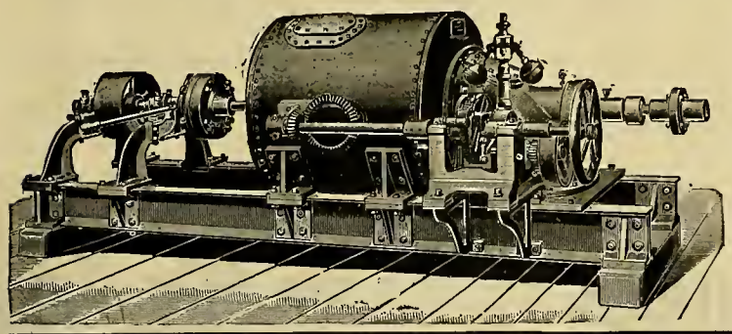

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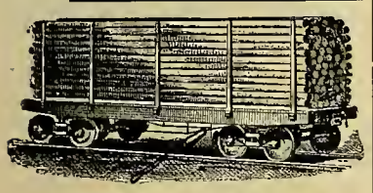

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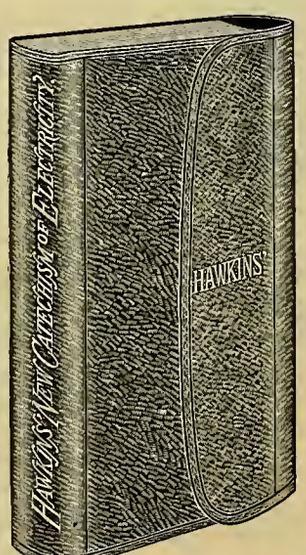

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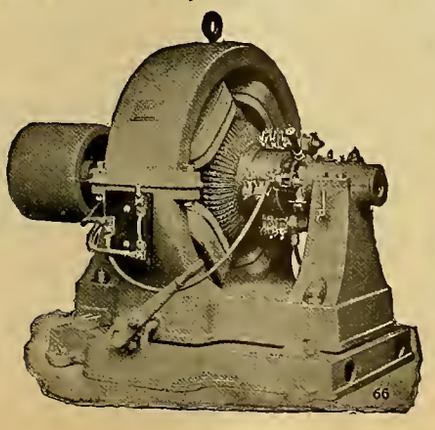

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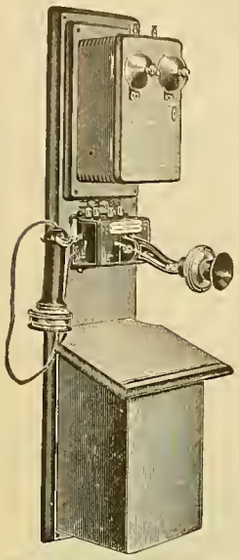

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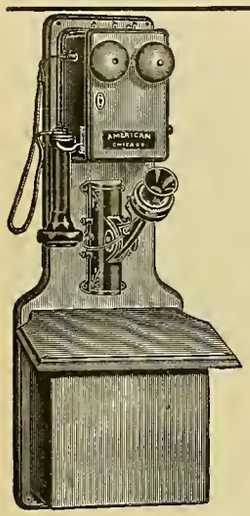

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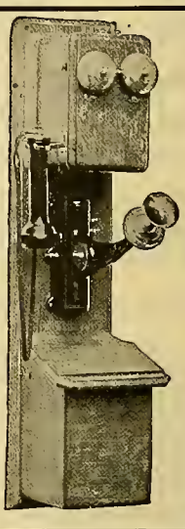

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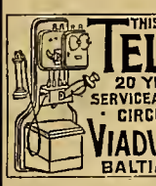

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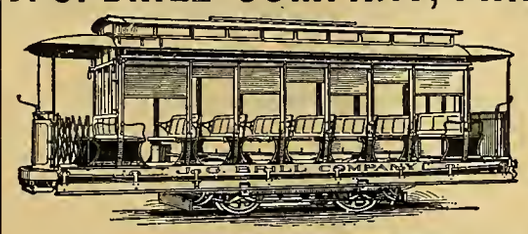

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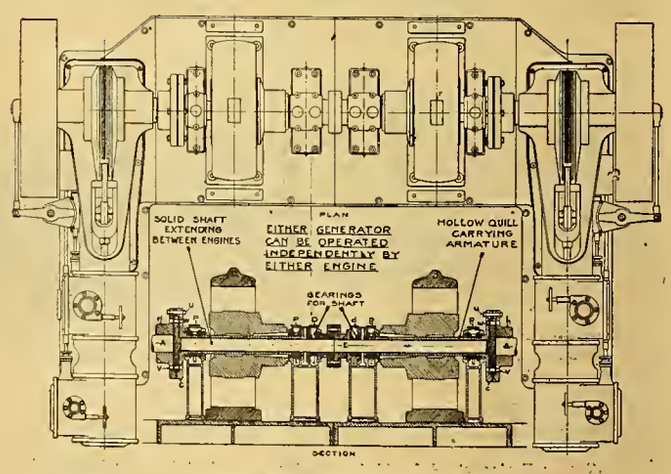

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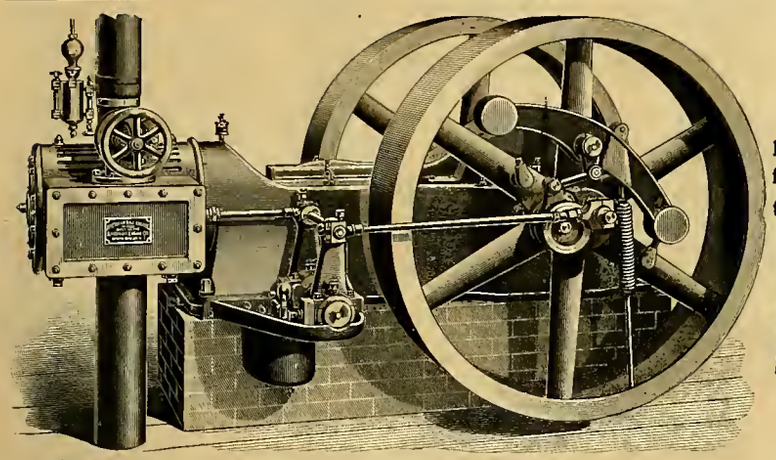

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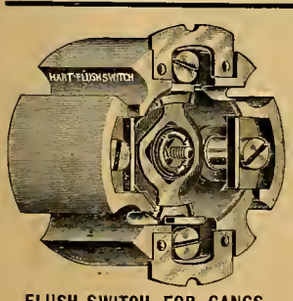

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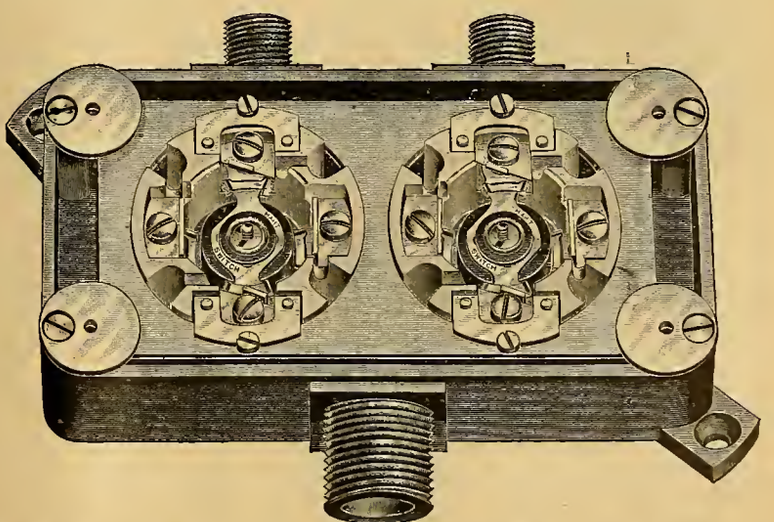

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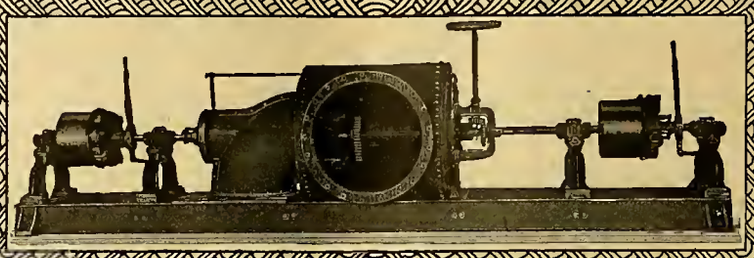

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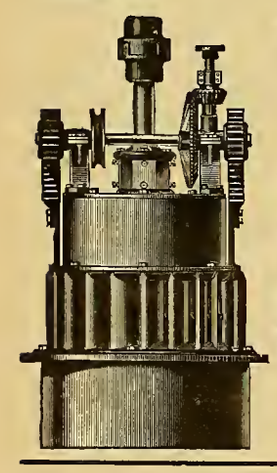

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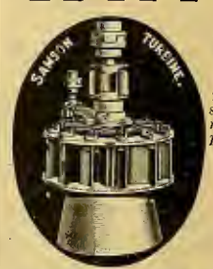

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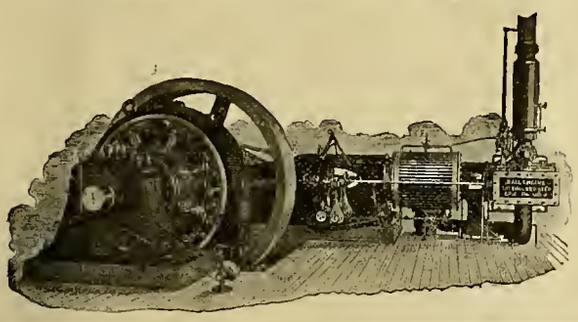

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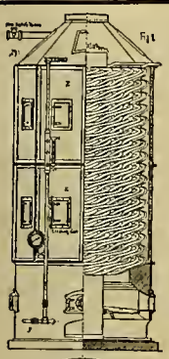

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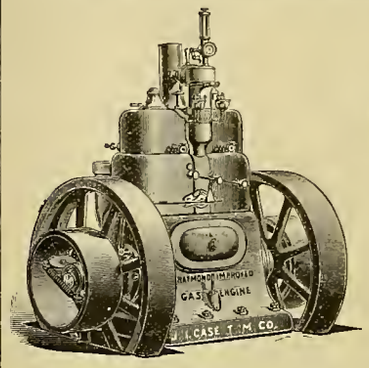

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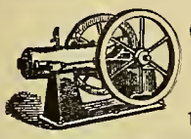

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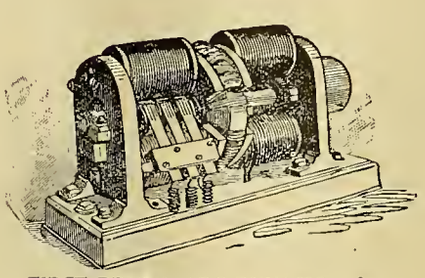

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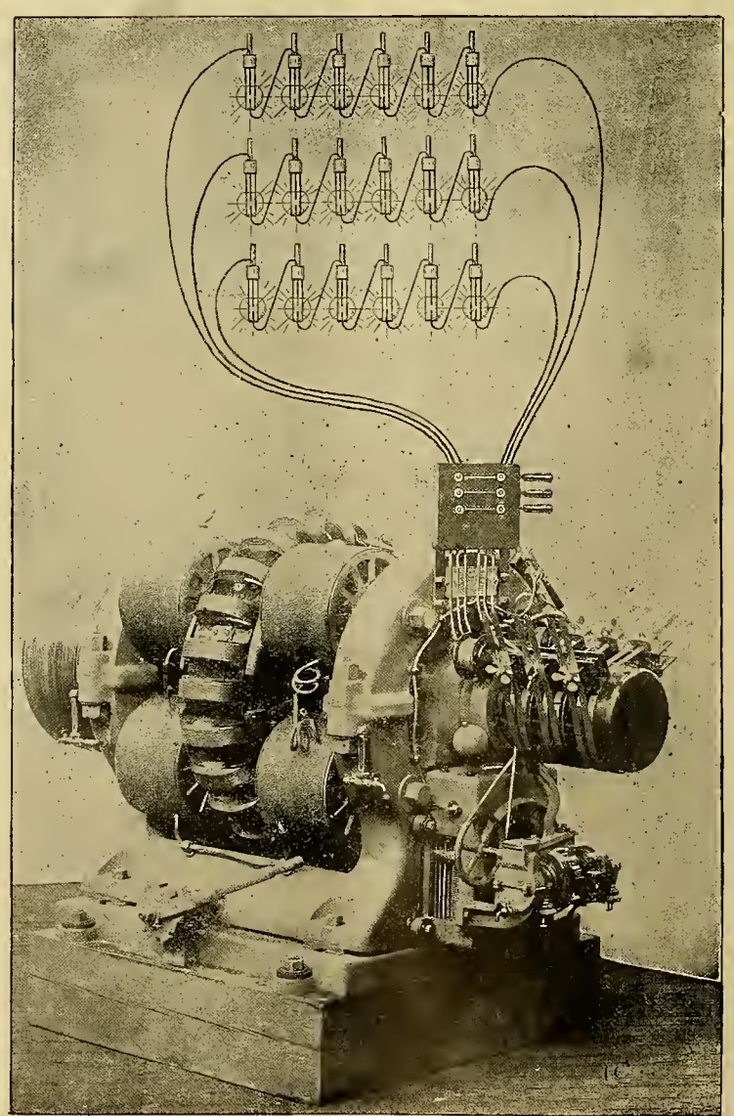

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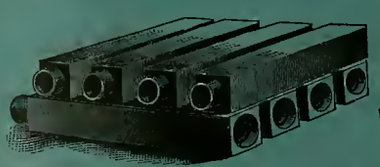

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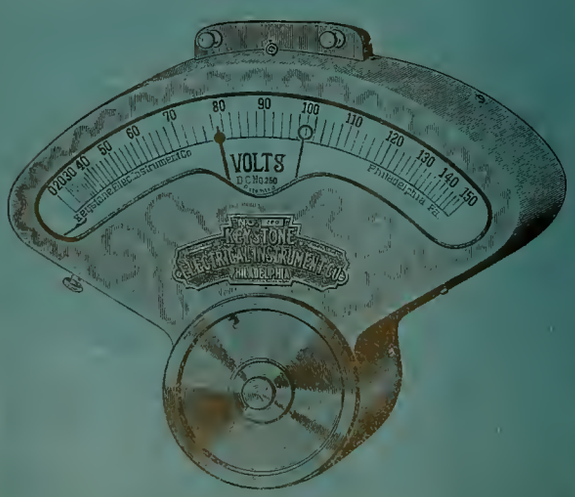

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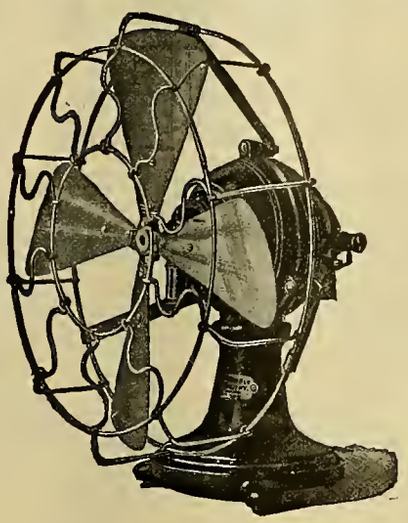

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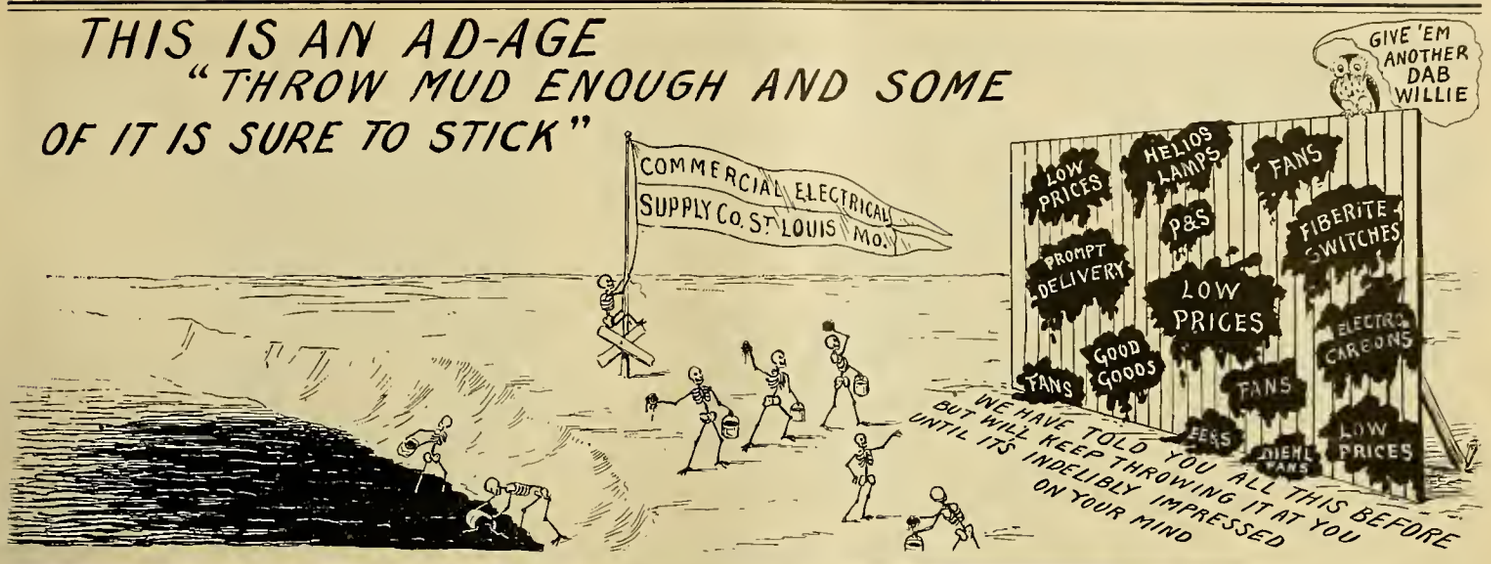

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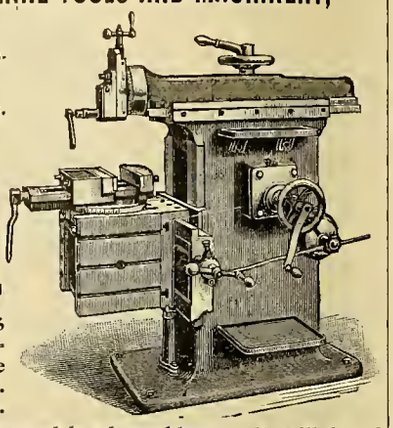

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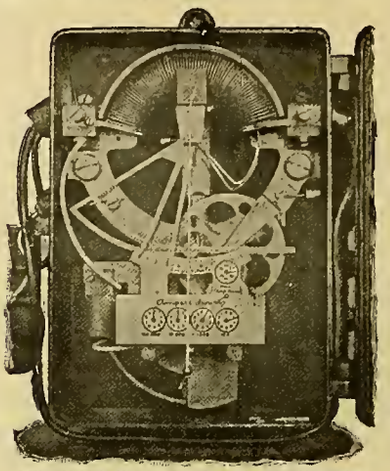

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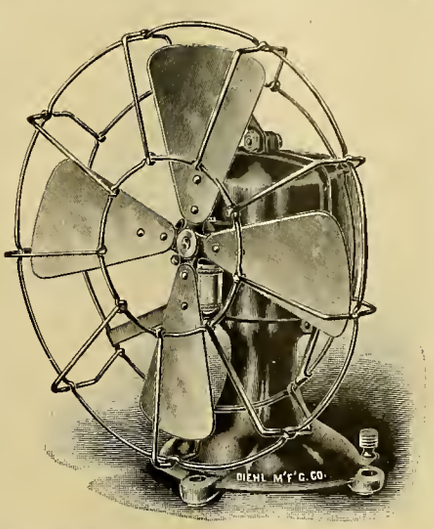

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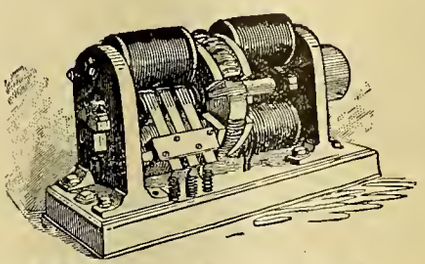

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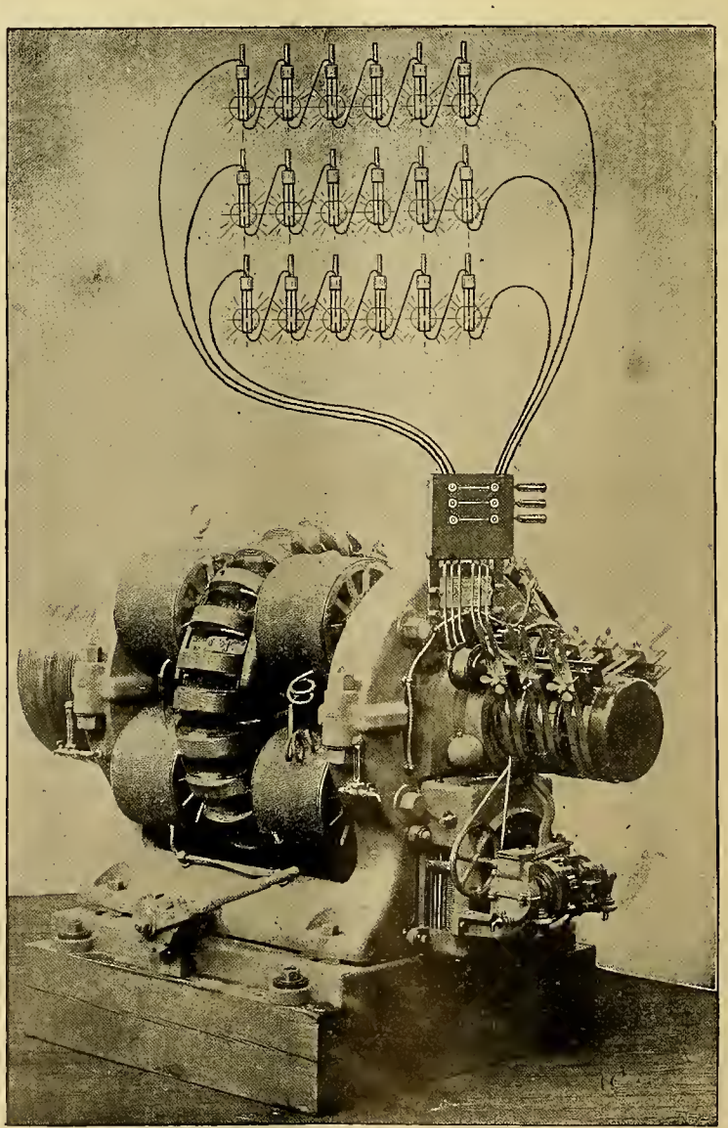

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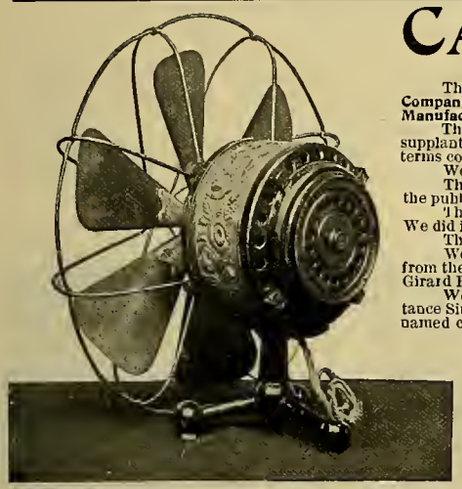

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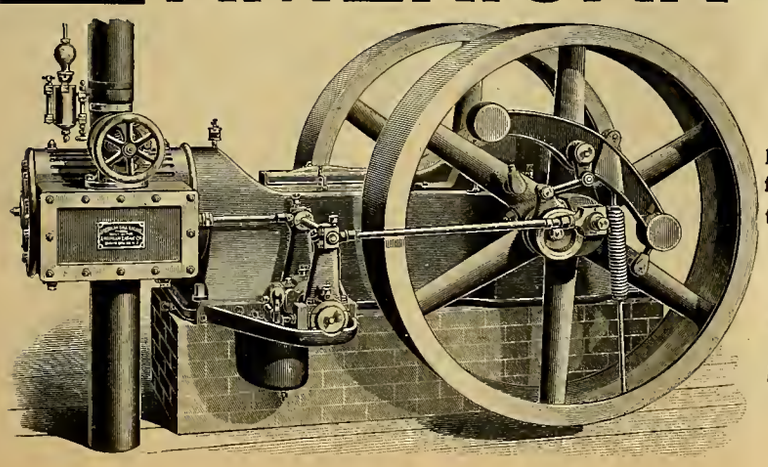

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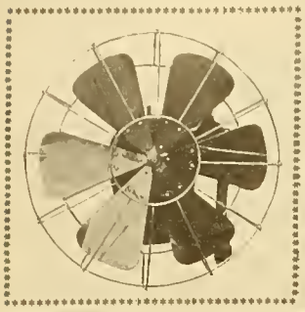

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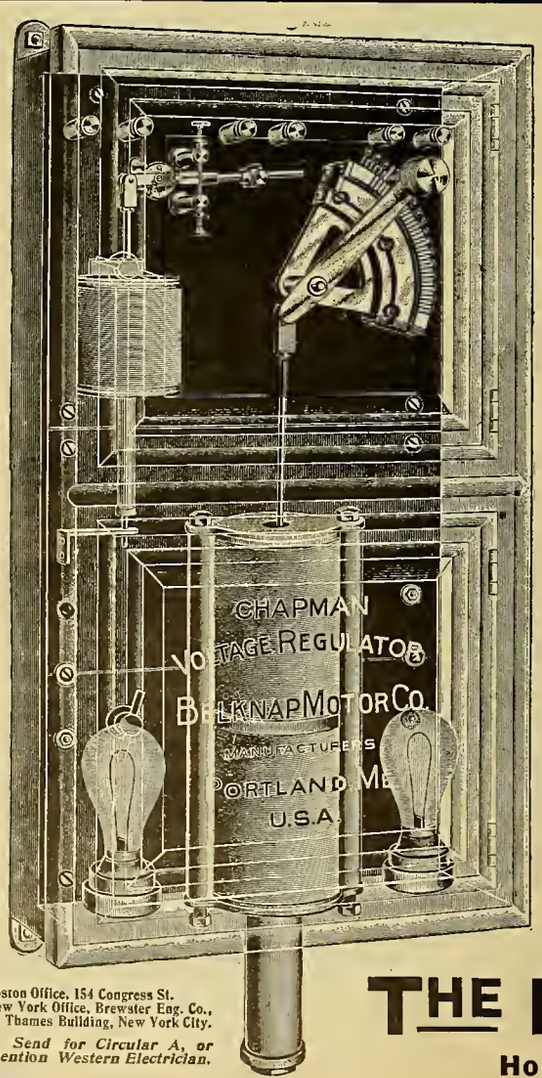

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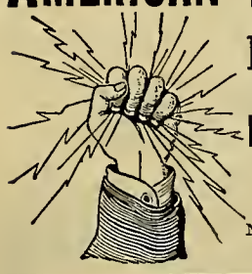

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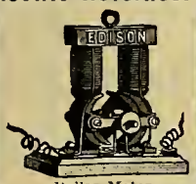

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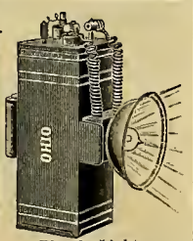

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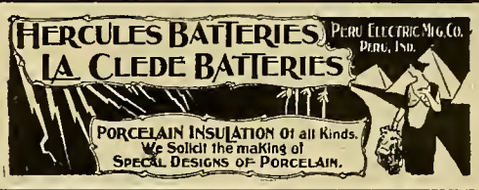

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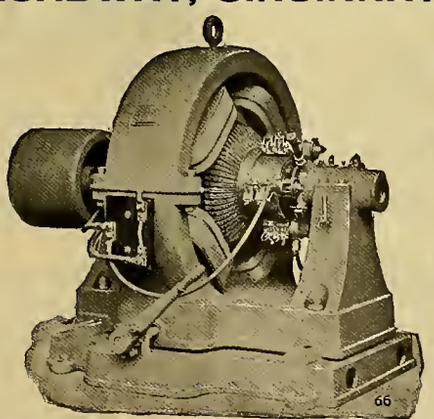

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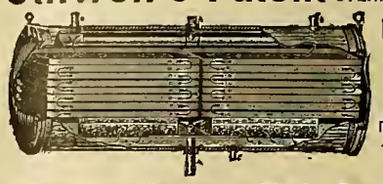

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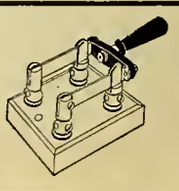

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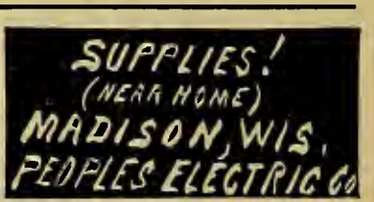

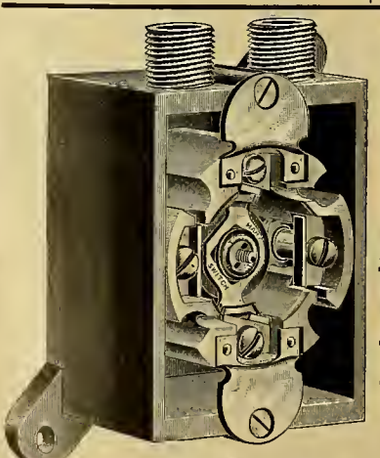

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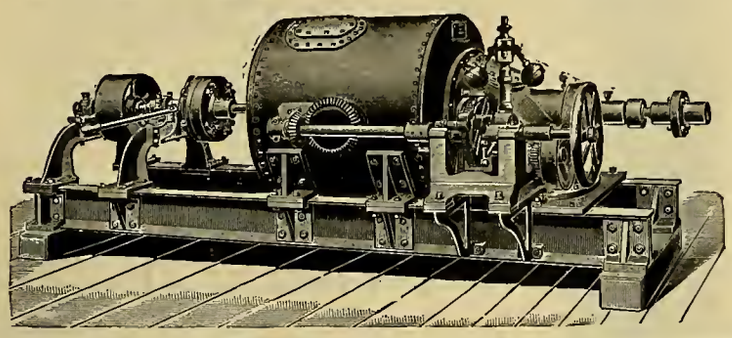

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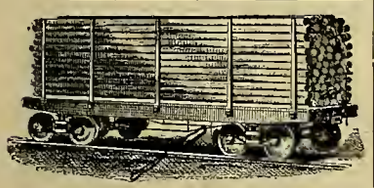

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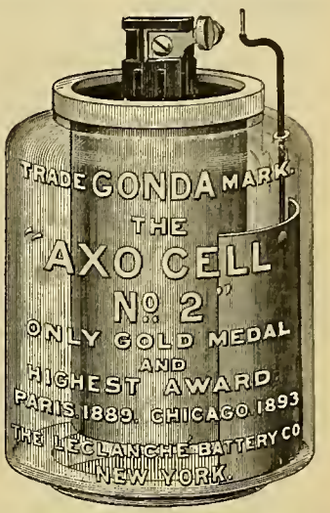

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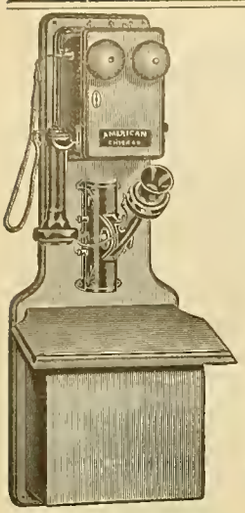

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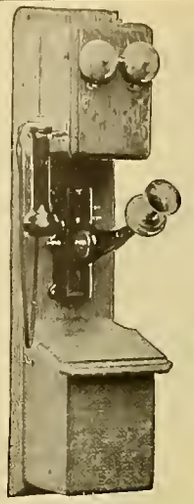

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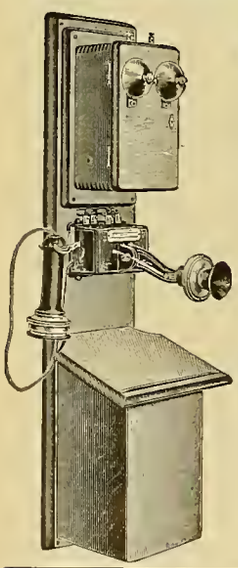

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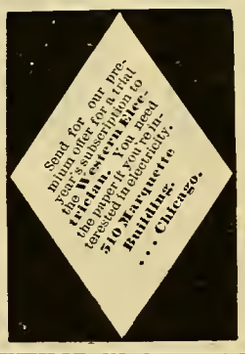

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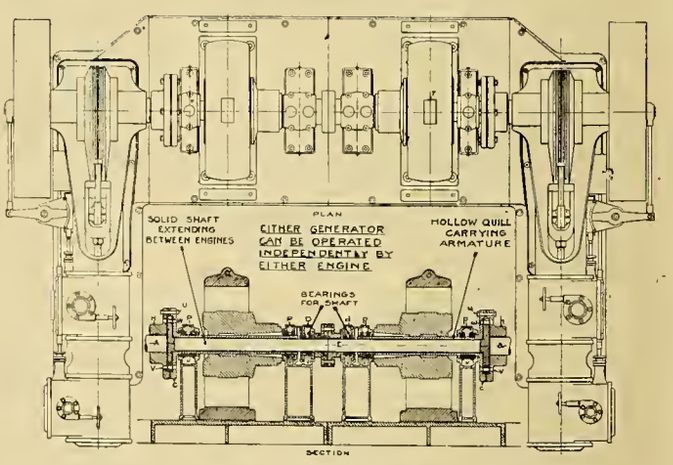

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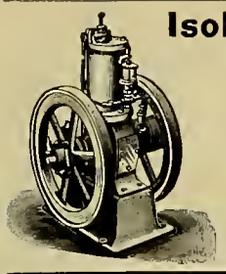

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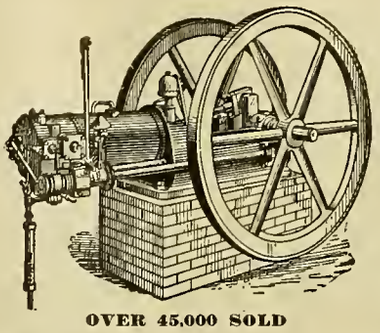

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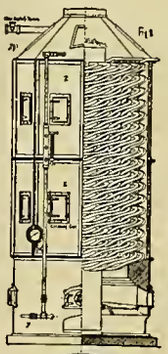

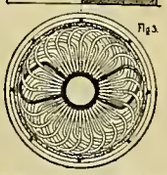

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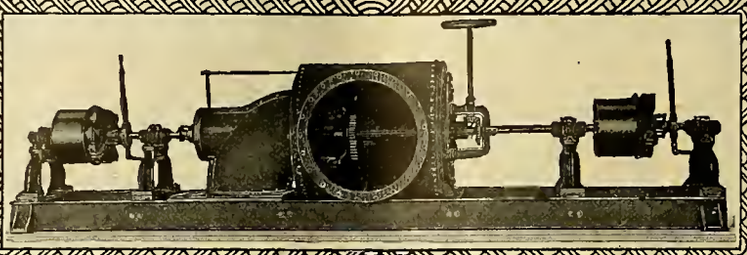

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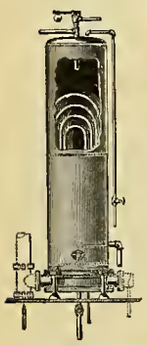

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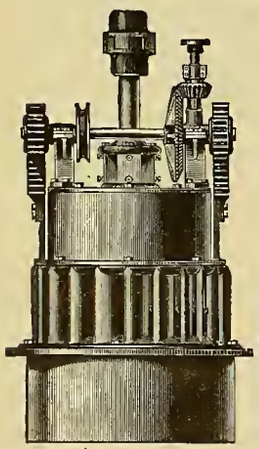

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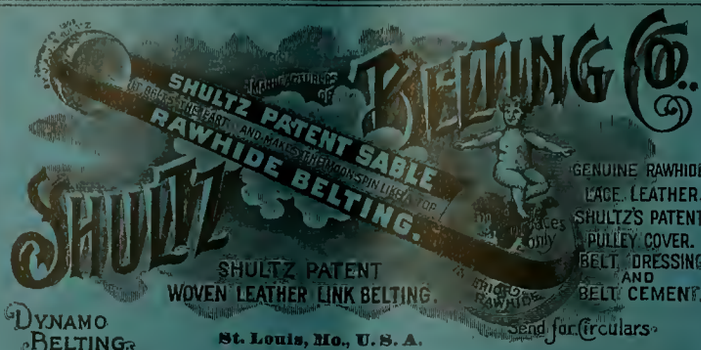

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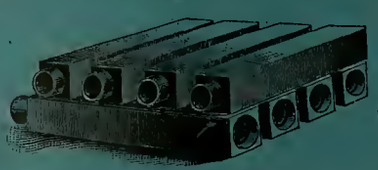

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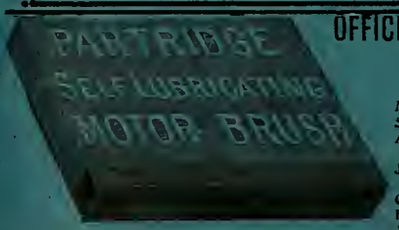

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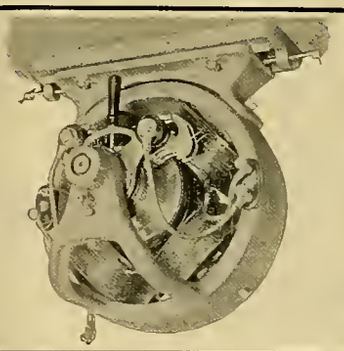

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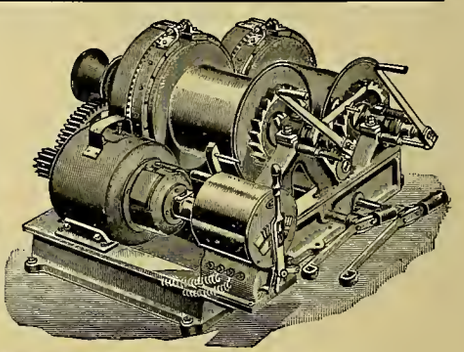

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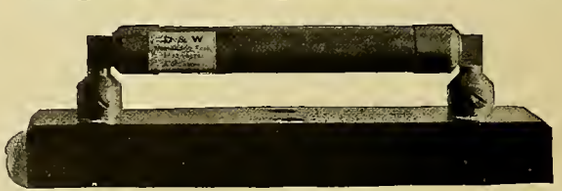

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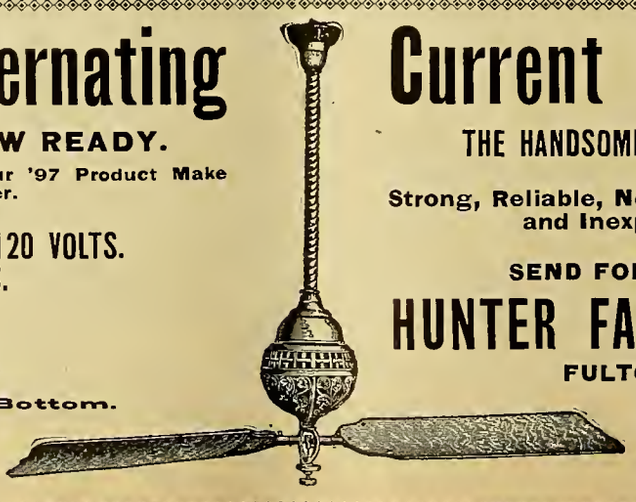

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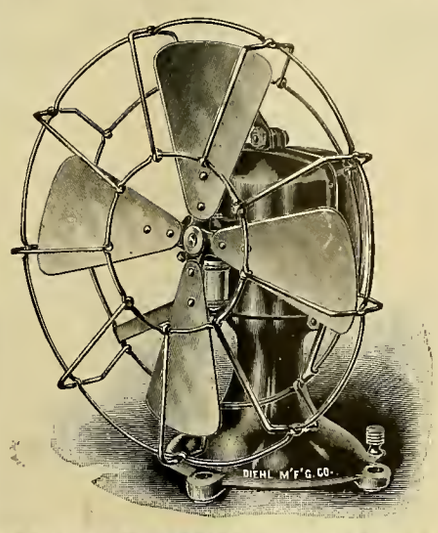

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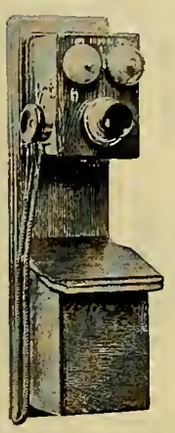

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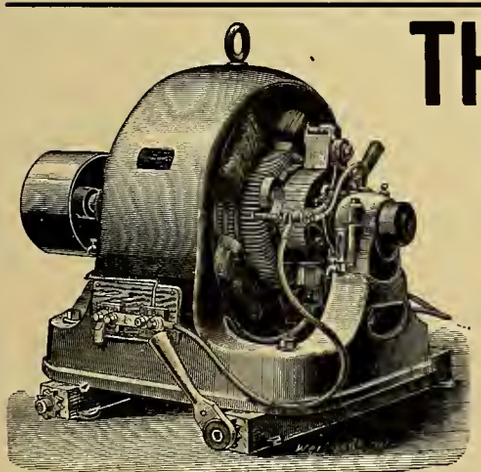

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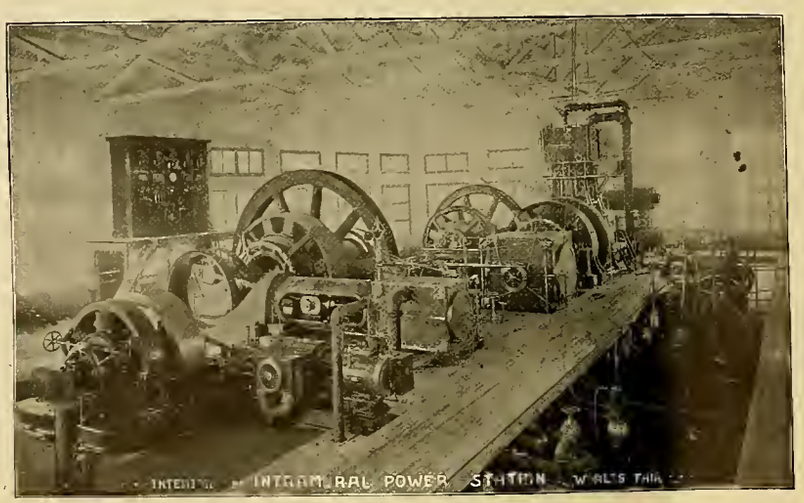

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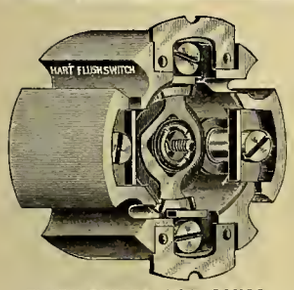

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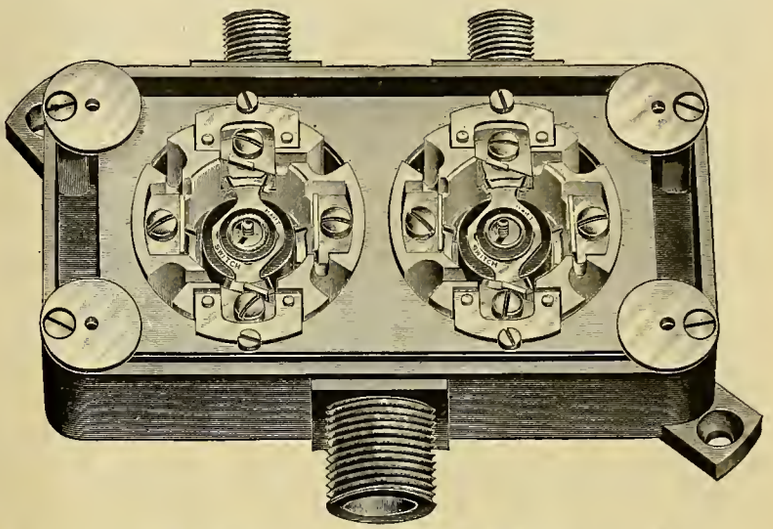

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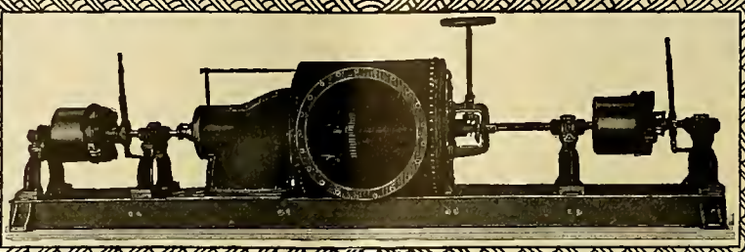

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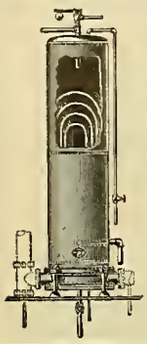

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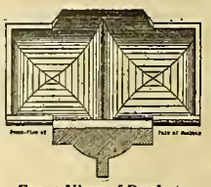

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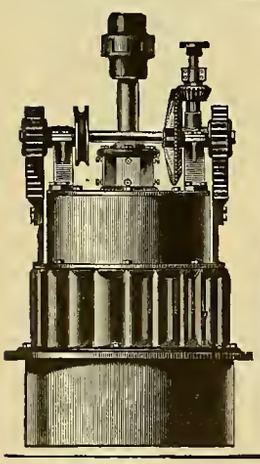

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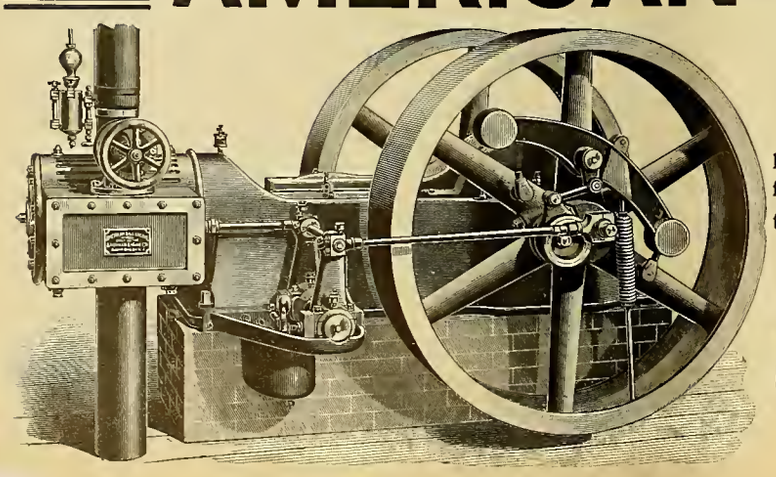

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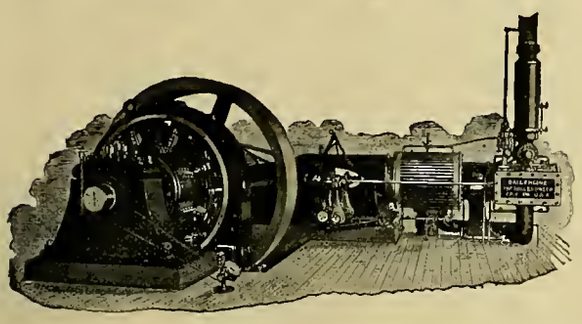

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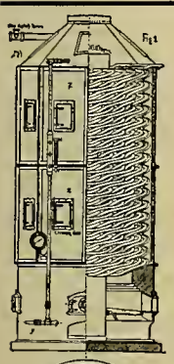

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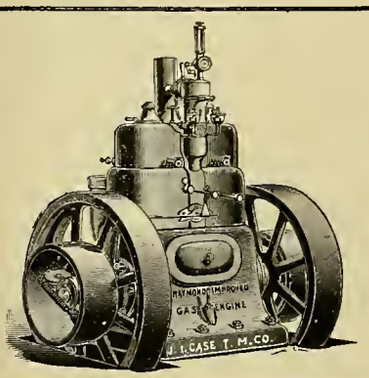

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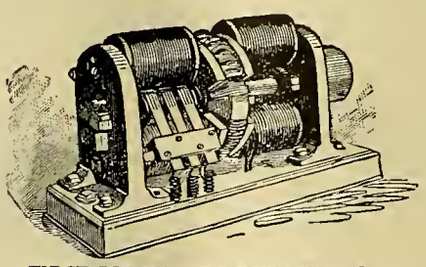

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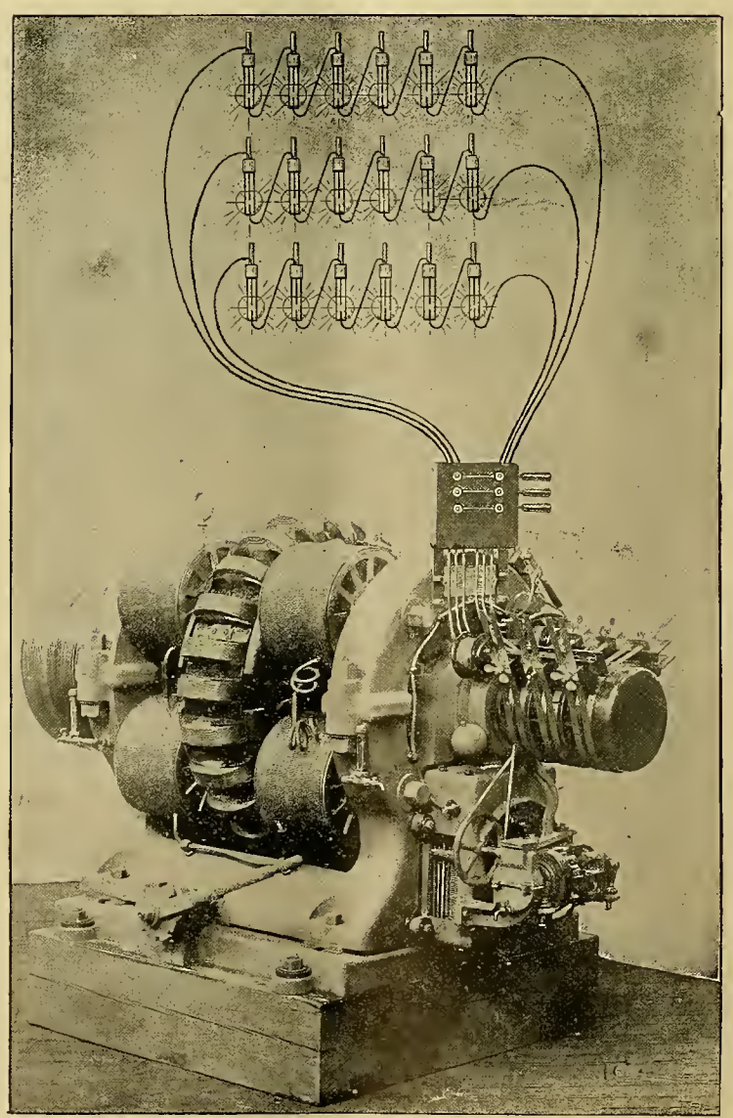

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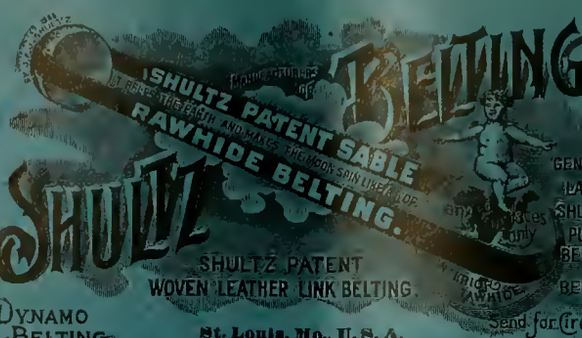

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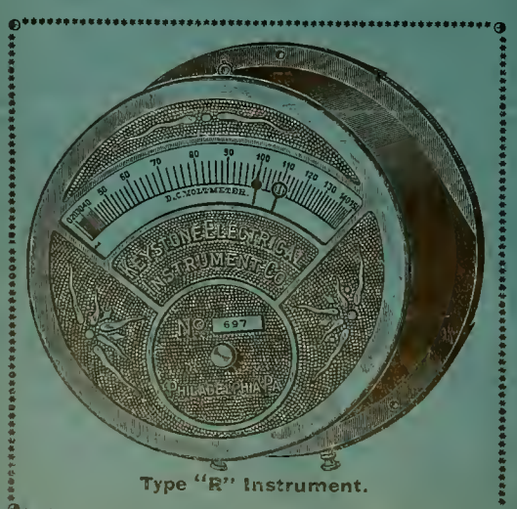

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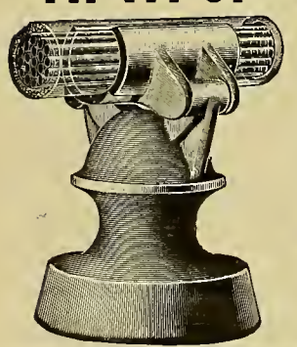

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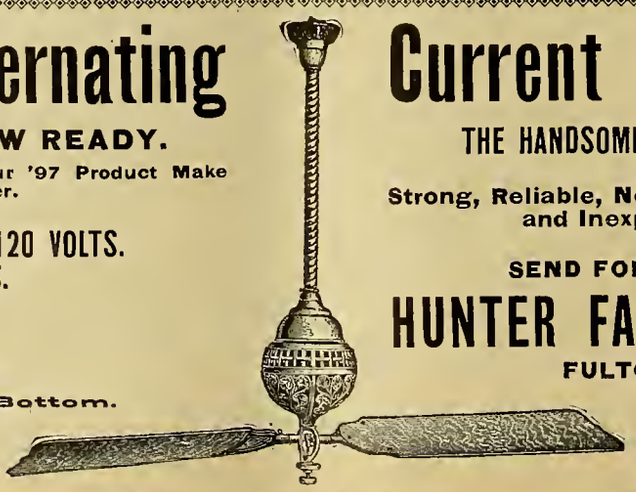

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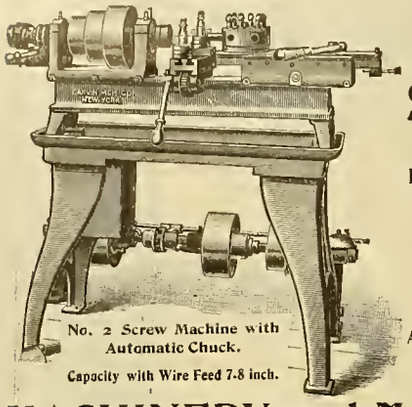

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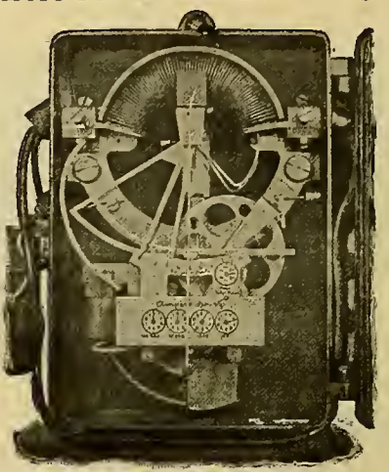

3-Wire 22-Light Meter. Case Open, Showing Mechanism.

The . . . American Electric Meter Co.,

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Electric Appliance Co.
Partrick & Carter Co.

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Swarts Metal Refining Co.

Reflectors.
Muir & Son, Thos.

Regulators.
Belknap Motor Co.

Re-Winding.
Central Electric Co.
Chicago Edison Co.
Eisele, J. E.
Electrical Exchange, The.
Hodge, Walsh & Loring.

Rheostats.
Am. El. Heat. Corporation.
Central Electric Co.
General Electric Co.
Iron Clad Rheostat Co.
Leonard, Ward, Elec. Co.
Muir & Son, Thos.
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Cornman Co.
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Shades.
Central Electric Co.
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Central Electric Co.
Electric Appliance Co.
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Besly & Co., Chas. H.
Central Electric Co.
Keystone El. Instrument Co.
Queen & Co.
Weston Electrical Inst. Co.

Steel Pipe.
National Tube Works Co.

Storage Batteries.
American Battery Co.
Central Electric Co.
Electric Storage Battery Co.
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Willard El. & Battery Co.

Tapes, Insulating.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Moore, Alfred F.
New York Insulated Wire Co
Okonite Co., The.
Simplex Electrical Co.
Washburn & Moen Mfg. Co.

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Commercial El. Supply Co.
Kusel, D. A., Tel. Mfg. Co.
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Western Tel. Cons. Co.
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Ft. Wayne Elec. Corporation
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Stanley Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

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Westinghouse El. & Mfg. Co.

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Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
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Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Wire, Bare.
Besly & Co., Chas. H.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co
Standard Underground C Co
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A DUPLICATE of the battery of **CHLORIDE ACCUMULATORS** installed in the United States Custom House, New York, a year ago, has just been contracted for; it will carry the night lamps in the Sub-Treasury and Assay office, and during the day, in connection with the original battery, it will regulate in the electric elevator service in the Custom House.

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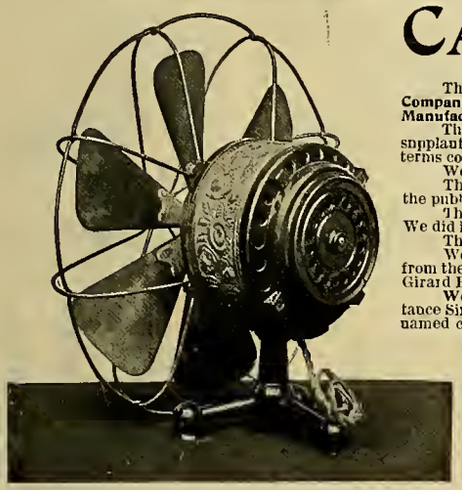

CARD TO THE PUBLIC.

The **General Electric Company, Westinghouse Electric Company, Thomson-Houston Electric Company** and the **Tesla Electric Company** have brought suits against the **Scott & Janney Electric & Manufacturing Company** for "alleged infringements" of their various patents.

This is the **USUAL "BLUFF"** that is brought to bear upon those whose inventions are bound to supplant the inventions of the above named and other large electrical concerns, who cannot at their own terms control such new inventions.

We are manufacturing under **our own patents** and **are not infringing.**

The above named firms are suing us upon a small fan motor as an excuse to get a chance to make the public believe that the state of the art is not history as far as they know it.

They have spent millions of dollars trying to invent apparatus to do certain things. They failed. We did invent it and have had it patented all over the world. **AND IT WORKS.**

They will try by strategy to do what they dare not do openly.

We wish to ask that the dealers and others who have received or will receive threatening letters from the above named concerns, will please send same to our attorneys, Messrs. Alexander & Magill, Girard Building, Philadelphia.

We are in the field to stay and do not propose to be intimidated. The Scott & Janney Long Distance Single Phase Alternating Railway and Power System will supersede the inventions of the above named companies. **AND THEY KNOW IT.**

FULL PROTECTION GUARANTEED TO ALL PURCHASERS OF OUR APPARATUS.

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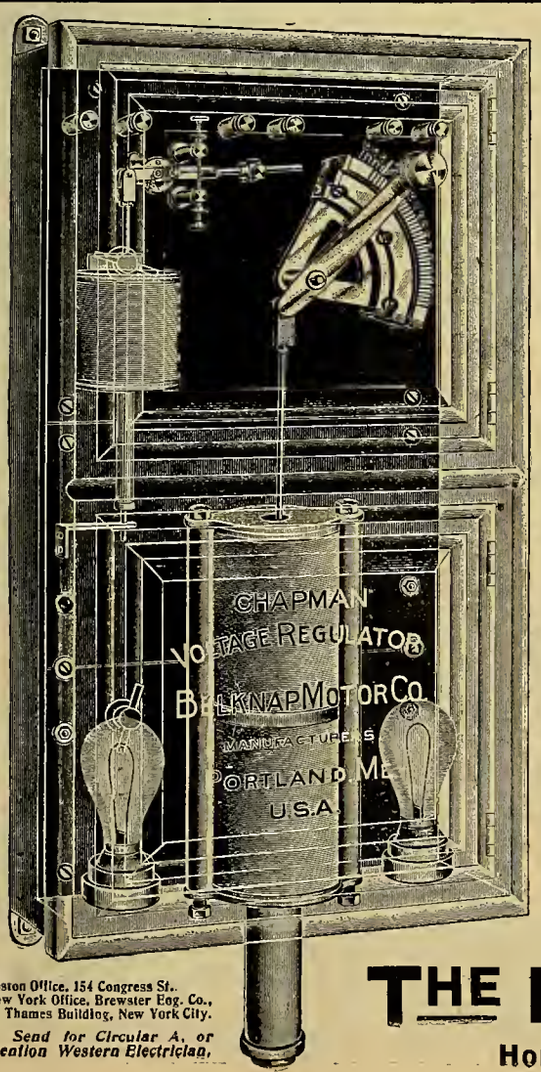

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Controls the voltage of varying speed dynamos.

Lamp renewals reduced.

Perfect regulation of voltage by an automatic device magnetically controlled. 25 to 50 per cent. variation in speed of water wheel or engine controlled within 2 per cent. of the normal, and it acts as quick as a circuit breaker. Every central station should have them. Generators can be worked nearer the limit of their capacity by their use, thus increasing their effective working power.

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Northfield Electric Co., Northfield, Vt.
Hollingsworth & Whitney Co., Waterville, Me.
Bar Mills Electric Co., Bar Mills, Me.
Forest Mills Co., Bridgton, Me.
Norway Electric Light Co., Norway, Me.
Crookston Water, Pr. & Lt. Co., Crookston, Minn.
Pondicherry Mills, Bridgton, Me.
Kingston Electric Co., Philadelphia, Pa.
Burgess Sulphite Co., Berlin, N. H.
Cliff Paper Co., Niagara Falls, N. Y.
Westbrook Electric Light Co., Westbrook, Me.
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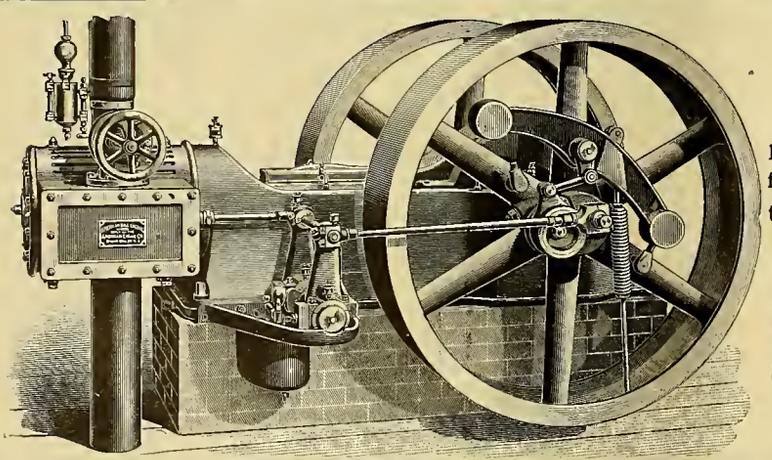

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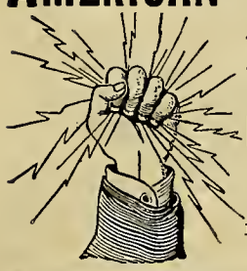

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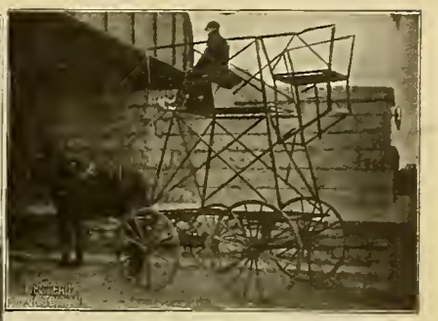

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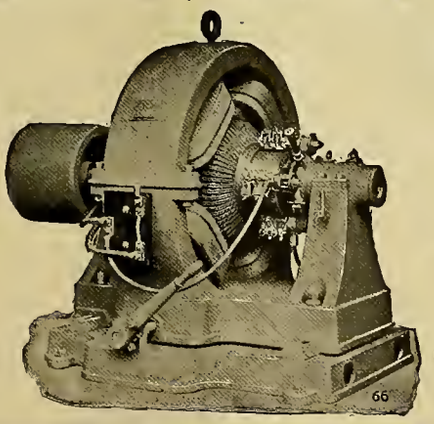

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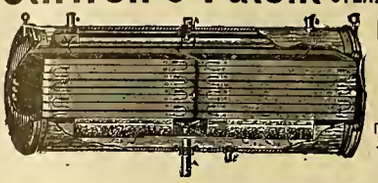

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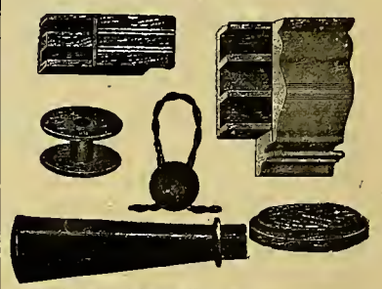

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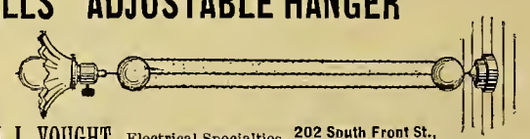

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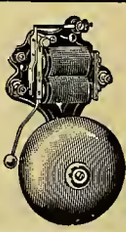

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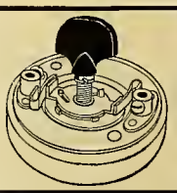

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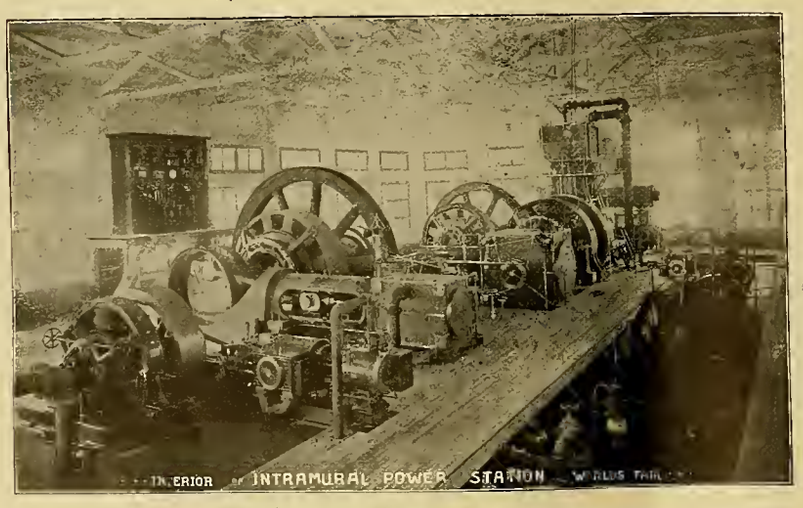

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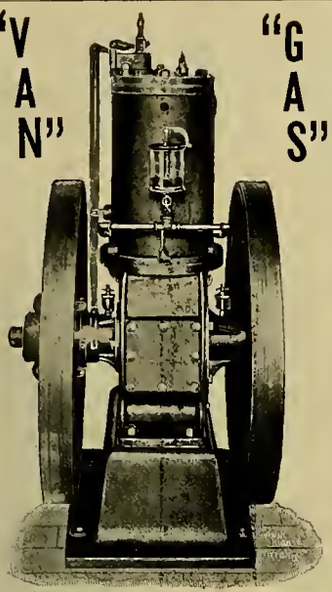

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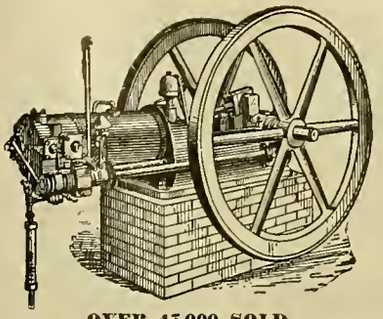

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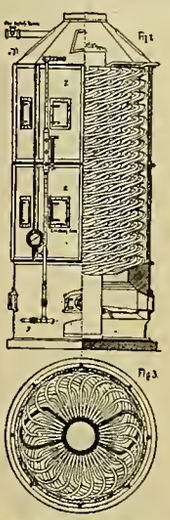

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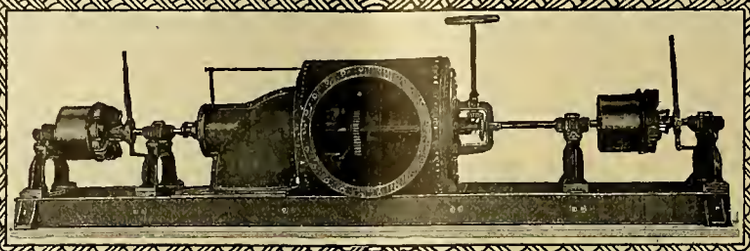

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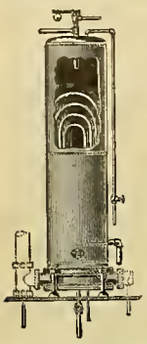

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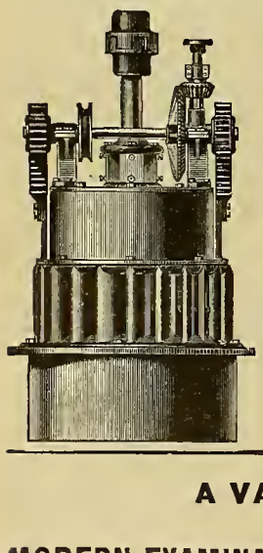

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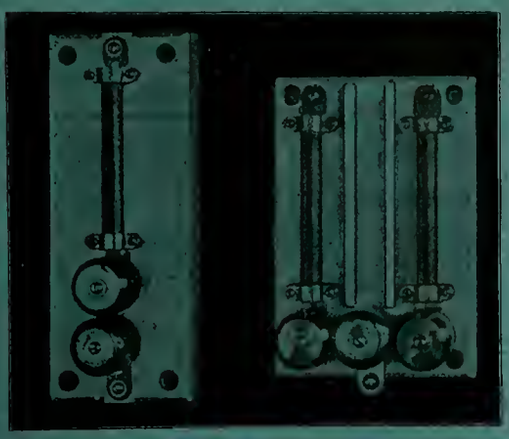

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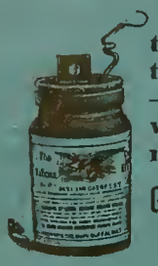

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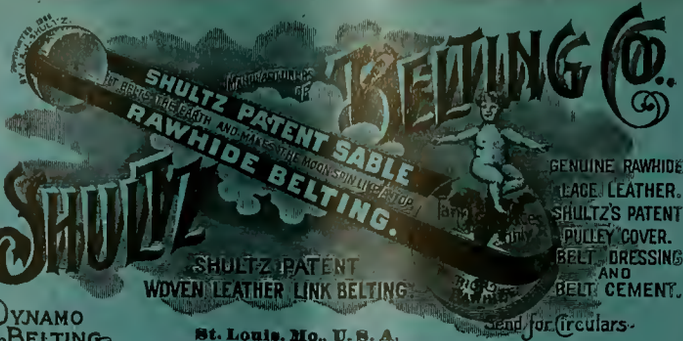

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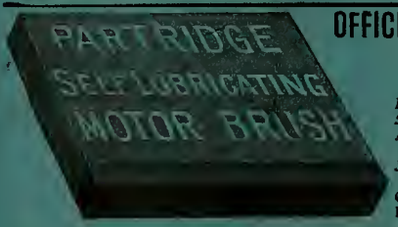

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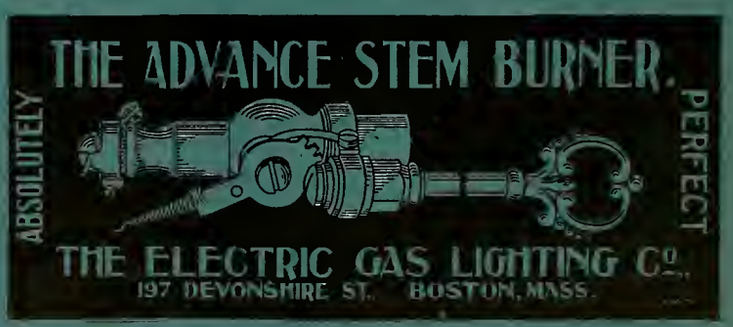

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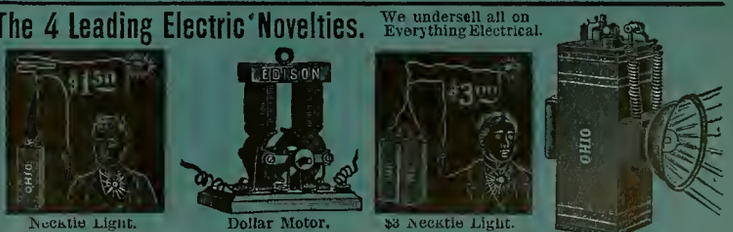

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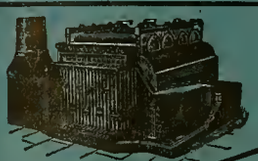

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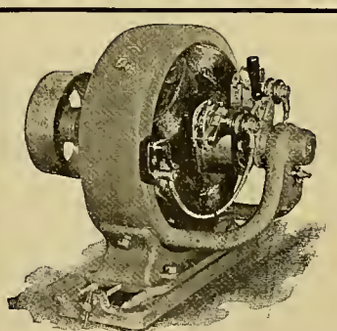

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FAN MOTORS.
CHICAGO EDISON COMPANY,
139 ADAMS STREET, CHICAGO.

THE ORIGINAL PATENTEES AND MANUFACTURERS OF

Cement-Lined Ducts

Engineers and Contractors for Complete Subways.

Address all Correspondence: **NEW HAVEN, CONN.**

The Connecticut Pipe Manufacturing Company,

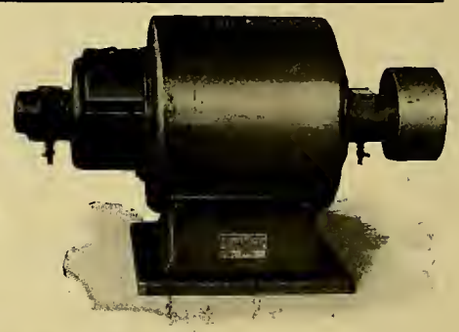
Office and Factory, West Haven, Conn.

Business Established 1865.
Incorporated 1892.

E. H. PHIPPS, President.
GEO. O. RICHARDS, Secretary.
CHARLES WARD, Gen. Mgr.

THE . . .

Storey Motors.



Iron-clad. Completely Closed In. Dust and Moisture Proof. No External Magnetism.

Specially Adapted for Direct Connection to Machinery.

Special Direct Current Motors for All Classes of Work.

THE STOREY MOTOR & TOOL CO.,

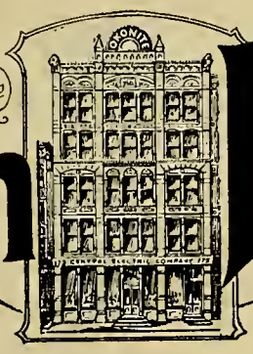
MAIN OFFICE AND FACTORY: 212-226 Carter St., Philadelphia, Pa.

BRANCH FACTORY: Hamilton, Canada.

AD STUDIO
COMMERCIAL
ELECTRICAL
SUPPLY
CO
ST LOUIS.

It's only Little Willie and the Old Man burning a signal fire to warn buyers to send in their names for **that Catalogue. It takes "fire" to make "smoke,"** so ask for **discounts.**

P. S.—And don't forget that we're always well stocked.



An Electrical Department Store

We have an Okonite Wire Department.
We have an Interior Conduit Department.
We have a Lundell Motor Department.
We have a Sawyer-Man Incandescent Lamp Department.
We have a Wagner Transformer Department.
We have a Helios Arc Lamp Department.
We have a Street Railway Department.
We Have a House Goods Department.

We also have a General Department from which everything pertaining to the electrical industries can be furnished. We also have an Order Department noted for its accuracy in completing complicated orders, and a Shipping Department whose sole mission is to get your goods started toward you with the greatest possible dispatch.

It is to your interest to get acquainted with us.

Geo. A. McKinlock, President.
Charles E. Brown, Secretary.
S. R. Frazier, Treasurer.

Central Electric Company,

1887–1897.

173-175 Adams Street, Chicago, Ill.

OKONITE IT NEVER DISAPPOINTS

KEYSTONE ELECTRIC CO.,

ELECTRICAL MACHINERY, ERIE, PA.

The Tuerk Alternating Current Ceiling Fan.

1897 PATTERNS NOW READY.

Some New Features Embodied in Our '97 Product Make It Better than Ever.

MADE FOR FROM 50 TO 120 VOLTS.
50, 125 AND 140 CYCLES.

SPECIAL FEATURES:
High Economy.
Self-Oiling Bearings.
Adjustable Blades.
Starting Switch at Bottom.

Five different styles of finish—Bronze, Bower-Barff, Ivory and Gold, Nickel, Polished Brass.

THE HANDSOMEST FAN ON THE MARKET.

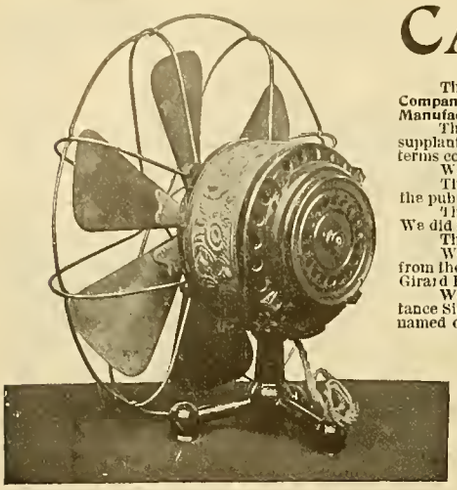
Strong, Reliable, Noiseless, Durable, Ornamental and Inexpensive to Operate.

SEND FOR 1897 CATALOGUE.

HUNTER FAN & MOTOR CO.,

FULTON, NEW YORK.

E. B. LATHAM & CO., General Selling Agents, 136 Liberty Street, New York, U. S. A.



CARD TO THE PUBLIC.

The General Electric Company, Westinghouse Electric Company, Thomson-Houston Electric Company and the Tesla Electric Company have brought suits against the Scott & Janney Electric & Manufacturing Company for "alleged infringements" of their various patents.

This is the USUAL "BLUFF" that is brought to bear upon those whose inventions are bound to supplant the inventions of the above named and other large electrical concerns, who cannot at their own terms control such new inventions.

We are manufacturing under our own patents and are not infringing.

The above named firms are suing us upon a small fan motor as an excuse to get a chance to make the public believe that the state of the art is not history as far as they know it.

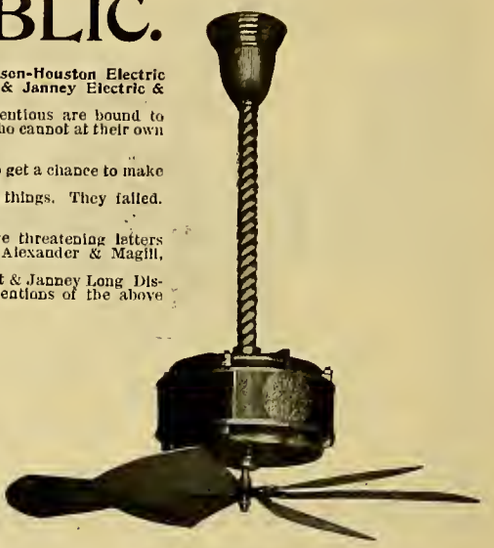
They have spent millions of dollars trying to invent apparatus to do certain things. They failed. We did invent it and have had it patented all over the world. AND IT WORKS.

They will try by strst gy to do what they dare not do openly.

We wish to ask that the dealers and others who have received or will receive threatening letters from the above named concerns, will please send same to our attorneys, Messrs. Alexander & Magill, Girard Building, Philadelphia.

We are in the field to stay and do not propose to be intimidated. The Scott & Janney Long Distance Single Phase Alternating Railway and Power System will supersede the inventions of the above named companies. AND THEY KNOW IT.

FULL PROTECTION GUARANTEED TO ALL PURCHASERS OF OUR APPARATUS.



The Scott & Janney Electric and Mfg. Co.,

1707-1709 Filbert Street, PHILADELPHIA.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Accumulators.
American Battery Co.
Central Electric Co.
Electric Storage Battery Co.
N. Y. Accum. & Electric Co.
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Willard El. & Battery Co.

Annunciators.
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Edwards & Co.
Electric Appliance Co.
Partrick & Carter Co.

Arc Lamps.
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Diehl Mfg Co.
Electric Arc Light Co.
Ft. Wayne Elec. Corporation.
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Gordon-Burnham Battery Co
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Huebel & Manger.
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Partrick & Carter Co.

Belting.
Jewell Belting Co.
Main Belting Co.
Peerless Rubber Mfg. Co.
Shultz Belting Co.

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Brushes.
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Holmes Fibre-Graphite Co.
Partridge Carbon Co.

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General Electric Co.
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McLennan & Co., K.
Okonite Co.

Conduits.
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Commercial El. Supply Co.
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Keystone Electric Co.
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United Elec. Imp. Co.
Warren Electric Mfg. Co.

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Ahlm-Edwards El. Co.
Arnold El. Pr. Station Co.
Bain, Foree.
Brush Electric Co.
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Card Electric Co.
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Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
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Hodge, Walsh & Loring.
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Peoples Electric Co.
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United Elec. Imp. Co.
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Westinghouse Elec & Mfg Co.

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Mitchell Temp Copper Co.

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Chicago Edison Co.
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Electric Appliance Co.
General Electric Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

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Samson Cordage Wks.

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Int. Correspond. Schools.

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Central Electric Co.
Commercial El. Supply Co.

Cross-Arms, Pins and Brackets.
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Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Point Marion Mfg. Co.

Cut-Outs and Switches.
Automatic Cir. Breaker Co.
Bryant Electric Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Cutter El. & Mfg. Co.
Eddy Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Elec. Co.
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Paiste Co., H. T.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Westinghouse El. & Mfg. Co.

Dynamos.
Ahlm-Edwards El. Co.
American Engine Co.
Brush Electric Co.
Bullock Elec Mfg. Co.
Card Electric Co.
Central Electric Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Keystone Electric Co.
Muir & Son, Thos.
Northern Electl. Mfg. Co.
Scott & Janney El. & Mfg. Co.
Siemens & Halske Elec. Co.
Triumph Electric Co.
United Elec. Imp. Co.
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Westinghouse El. & Mfg. Co.

Economizers, Fuel.
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Electric Heat'g App's.
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Central Electric Co.
Globe Electric Heating Co.
Johns, H. W., Mfg. Co.

Electric Meters.
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Zamel Arc Light Meter Co.

Electric Railways.
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Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Bain, Foree.
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Pratt. Chas. A.

Electrical Instruments.
Automatic Cir. Breaker Co.
Central Electric Co.
Commercial El. Supply Co.
Cutter El. & Mfg. Co.
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Automatic Cir. Breaker Co.
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Hill, W. S. Electric Co.
Paiste Co., H. T.
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Ball Engine Co.

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Hunter Fan & Motor Co.
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Wagner Electric Mfg. Co.
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Westinghouse El. & Mfg. Co.

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Davis & Son, I. B.

Fibre.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
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Commercial El. Supply Co.

Fuses.
D. & W. Fuse Co.

Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
Commercial El. Supply Co.
Electric Appliance Co.

Gaskets.
Johns, H. W., Mfg. Co.
Peerless Rubber Mfg. Co.

Gas Lighting, Electric.
Central Electric Co.

Gears.
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Central Electric Co.

General Elec. Supplies.
Besly & Co., Chas. H.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
General Electric Co.
Hill, W. S. Electric Co.
Hodge, Walsh & Loring.
Ohio Electric Works.
Paiste Co., H. T.
Partrick & Carter Co.
Peoples Electric Co.
Peru Elec. Mfg. Co.

Globes and Electrical Glassware.
Central Electric Co.
Commercial El. Supply Co.

Gov'nors, Water Wheel.
Lombard Water Wheel Gv. Co.

Graphite Specialties.
Besly & Co., Chas. H.
Central Electric Co.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Induction Coils.
Central Electric Co.
Queen & Co.

Insulators and Insulating Materials.
Brixey, W. R.
Bryant Electric Co.
California Asphalt Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
Empire China Works.
Hill, W. S. Electric Co.
Hodge, Walsh & Loring.
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Mica Insulator Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Paiste Co., H. T.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

Lamp Adjusters.
Vought, M. I.

Lamps, Incandescent.
Buckeye Electric Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
General Electric Co.,
Lynn Incandescent Lp. Co.
Ohio Electric Works.
Sawyer-Man Elec. Co.
United Elec. Imp. Co.
Warren Elec. & Specialty Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamp Trim'r's Wagons.
Studebaker Bros. Mfg. Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Westinghouse El. & Mfg. Co.

Magnet Wire.
(See Insulated Wires.)

Mechanical Machinery.
Besly & Co., Chas. H.
Garvin Machine Co., The.
Stilwell-Bierce Smith-Valle.

Mica.
Central Electric Co.
Commercial El. Supply Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
General Electric Co.
Westinghouse El. & Mfg. Co.

Motors.
Ahlm-Edwards Elec. Co.
American Engine Co.
Belknap Motor Co.
Brush Electric Co.
Bullock Elec. Mfg. Co.
Card Electric Co.
Central Electric Co.
Commercial El. Supply Co.
Crocker-Wheeler Elec. Co.
Dalletf & Co., Thos. H.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Keystone Electric Co.
Muir & Son, Thos.
Northern Electl. Mfg. Co.
Ohio Electric Works.
Peoples Electric Co.
Scott & Janney El. & Mfg. Co.
Stanley Elec. Mfg. Co.
Storey Motor & Tool Co.
Triumph Electric Co.
United Elec. Imp. Co.
Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

Packing.
Besly & Co. Chas. H.
Garlock Packing Co.
Johns, H. W., Mfg. Co.
Peerless Rubber Mfg. Co.

Paints.
California Asphalt Co.
Central Electric Co.
Commercial El. Supply Co.
Johns, H. W. Mfg. Co.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co. Ltd.

Platinum.
Baker & Co.

Poles.
Carley, Ira.
Lindsley Bros.
McLean, A. J.
National Tube Works Co.
Perrizo & Sons.
Point Marion Mfg. Co.
Sterling & Son, W. C.

Porcelain.
Bryant Electric Co.
Central Electric Co.
Commercial El. Supply Co.
Empire China Works.
Peru Elec. Mfg. Co.

Push Buttons.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Partrick & Carter Co.

Refiners.
Swarts Metal Refining Co.

Reflectors.
Muir & Son, Thos.

Regulators.
Belknap Motor Co.

Re-Winding.
Central Electric Co.
Chicago Edison Co.
Eisele, J. E.
Electrical Exchange, The.
Elliott, W. H. Elec. Co.
Hodge, Walsh & Loring.

Rheostats.
Am. El. Heat. Corporation.
Central Electric Co.
General Electric Co.
Iron Clad Rheostat Co.
Leonard, Ward, Elec. Co.
Muir & Son, Thos.
Westinghouse El. & Mfg. Co

Second-Hand Machin'y.
Cornman Co.
Electrical Exchange, The.
Elliott, W. H. Elec. Co.

Shades.
Central Electric Co.
Muir & Son, Thos.

Speaking Tubes.
Central Electric Co.
Electric Appliance Co.
Partrick & Carter Co.

Speed Indicators.
Besly & Co., Chas. H.
Central Electric Co.
Keystone El. Instrument Co.
Queen & Co.
Weston Electrical Inst. Co.

Steel Pipe.
National Tube Works Co.

Storage Batteries.
American Battery Co.
Central Electric Co.
Electric Storage Battery Co.
N. Y. Accum. & Electric Co.
Ohio Storage Battery Co.
Willard El. & Battery Co.

Tapes, Insulating.
American Electrical Works.
Brixey, W. R.
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Commercial El. Supply Co.
Electric Appliance Co.
Moore, Alfred F.
New York Insulated Wire Co
Okonite Co., The.
Simplex Electrical Co.
Washburn & Moen Mfg. Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Commercial El. Supply Co.
Kusel, D. A., Tel. Mfg. Co.
Lockwood T. & T. Co. of Am
Orne Elec. Cons. Co.
Peoples Electric Co.
Standard Tel. & El. Co.
Stromberg-Carlson Tl. M. Co.
Taber & Mayer.
Viaduct Mfg. Co.
Western Tel. Cons. Co.

Transformers.
Central Electric Co.
Commercial El. Supply Co.
Diamond Elec. Co.
Ft. Wayne Elec. Corporation
General Electric Co.
Stanley Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

Trolley Cord.
Central Electric Co.
Samson Cordage Wks.

Trucks, Electric Car.
Brill Co., J. G.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle.

Water Wheels.
Am. Impulse Wheel Co.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle

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Brixey, W. R.
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Standard Underground C. Co
Washburn & Moen Mfg. Co.

X Bay Outfits.
Central Electric Co.
Commercial El. Supply Co.
Queen & Co.

For Alphabetical Index of Advertisements See Page III.

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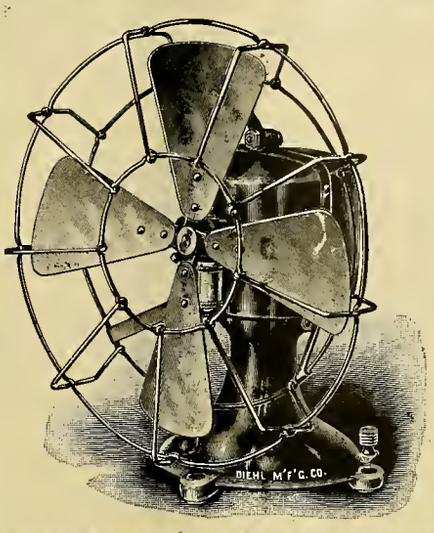
Ceiling Fans and Exhaust Wheels

Wound for Any Current, Except Alternating.

Our Exhaust Wheel Combinations

Are the most compact and efficient made.
Write for catalogue and prices.



Propeller or Desk Fans

Wound for 110, 220 or in series on 500 volts.
Also for Primary or Secondary Battery Circuits.

Highest Efficiency

Unbroken Magnetic Circuit, Self-Aligning Bronze Bearings. Finest Insulation Throughout. Four-Speed Regulator.

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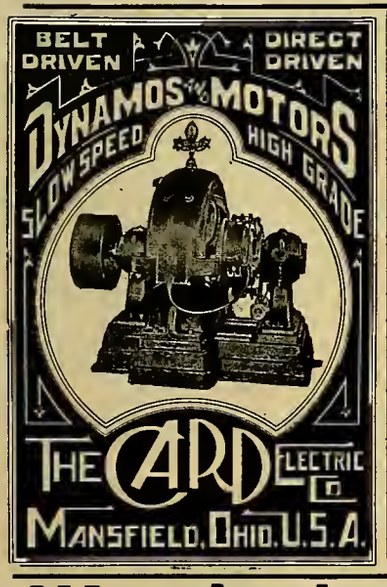
DIEHL MANUFACTURING CO., ELIZABETHPORT, NEW JERSEY.

Agents for Canada: Canadian General Electric Co., Toronto, Ontario.



DALLETT
Electric Motors and Generators,

MANUFACTURED BY

THOS. H. DALLETT & CO.,

York St. and Sedgley Ave.,
PHILADELPHIA, PA.

Portable Electric Drills, Starting Boxes and Controllers,

Automatic Switches. . . . . .
Flexible Insulated Couplings.

FUSE WIRE AND LINKS FOR ALL SYSTEMS. Correct Carrying Capacity. Absolutely Uniform.

CHICAGO FUSE WIRE & MFG. CO.,
153 Lake St., Chicago.

Westinghouse Polyphase Apparatus Supreme.

Generators, Motors, Transformers, for Two-Phase, Three-Phase and C. F. Scott Two-Phase Three-Phase System of Alternating Current Power Transmission.

26,000 H. P. IN OIL-INSULATED TRANSFORMERS CONSTRUCTED.

Potentials from 5,000 to 50,000 Volts. All Apparatus Necessary for 100 Mile Transmission.

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.,
PITTSBURG, PA.

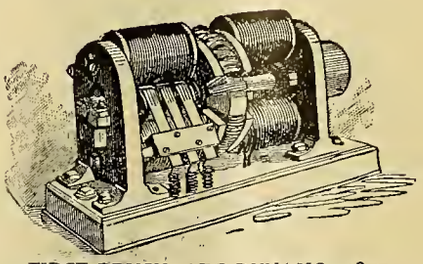
New York, 120 Broadway.
Boston, Exchange Bldg.
Buffalo, N. Y., 8 Erie Co. Bank Bldg.
Charlotte, N. C., 36-38 College St.
Chicago, N. Y. Life Bldg.
Philadelphia, Girard Bldg.
Pittsburg, Westinghouse Bldg.
St. Louis, American Central Bldg.
San Francisco, Mills Bldg.
Syracuse, N. Y., Bastable Bldg.
Tacoma, Wash., 102 S. 10th St.
Atlanta, Ga., Equitable Bldg.
Westinghouse Electric Co., Ltd., 32 Victoria St., London, S. W., England.
For Canada address Ahearn & Soper, Ottawa, Ont.

THE BRUSH ELECTRIC COMPANY.

BRUSH

THE BRUSH ELECTRIC COMPANY.

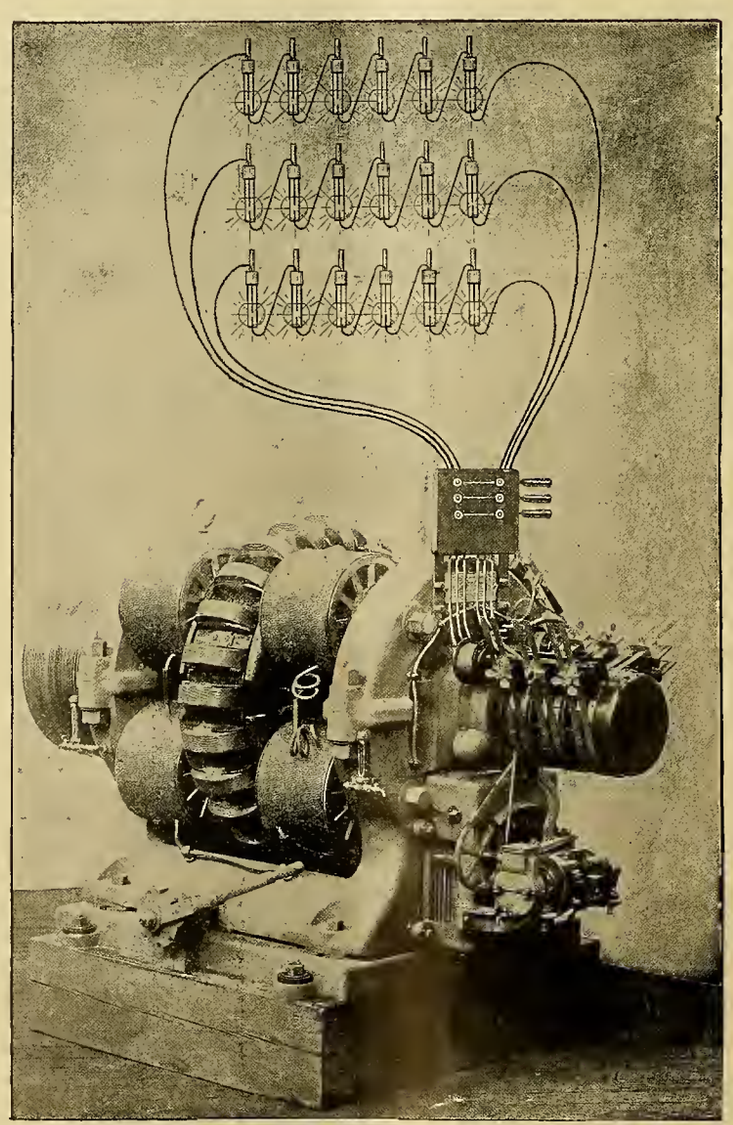
Brush apparatus has been on the market for 20 years. A majority of customers order supply parts direct from us. Many do not. We want this trade and are reducing our prices in order to secure it. Ask for quotations and send orders to the nearest Sales Office.



FIRST BRUSH ARC DYNAMO—1877

SALES OFFICES:
Schenectady, N. Y.
Cleveland, Ohio.
Boston, Mass., 180 Summer Street.
New York, N. Y., 44 Broad Street.
Philadelphia, Pa., 509 Arch Street.
Cincinnati, Ohio, 420 West Fourth Street.
Chicago, Ill., Monadnock Building.
St. Louis, Mo., Wainwright Building.
Atlanta, Ga., Equitable Building.
Denver, Colo., Kittredge Building.
San Francisco, Cal., 15 First Street.
Toronto, Ont., Canadian General Electric Co., Ltd.
Pittsburg, Pa., Carnegie Building.

Many stations have exchanged all their small units for large Brush arc dynamos. Among them are the Brooklyn-Citizens with 3000 lights capacity. Brooklyn-Municipal 800, Newark 3000, Cleveland 1800, Philadelphia Brush 1500, Philadelphia-Northern 1300, Buffalo 1500, Worcester 1400, Toronto 900, Quebec 625, Harrisburg 750, Erie 750, Albany 500, Troy 500, Paterson 500, City of Chicago 400, John Wanamaker 625, Carnegie Steel Co. 500.



BRUSH MULTI-CIRCUIT 125 LIGHT ARC DYNAMO—1897.

Over 40,000 lights capacity in large Brush arc dynamos sold. A large proportion of them using Multi-Circuit Dynamos.

The newly designed Brush dynamos have the following capacities; 55, 80, 100, 125, 240, 300, 2000 candle-power lights, 45, 85, 120, 160, 1200 candle-power lights.

Brush arc lamps were first used in 1877. More of them being sold to-day than ever before.

Two or more separate circuits run direct from one dynamo with any distribution of load on the different circuits. The advantages are absolute flexibility in handling of circuits; reduction of high voltages on circuits run from large dynamos; use of large units with corresponding increase of efficiency; saving in floor space, oil, belts, shafting, pulleys, attendance.

WHAT MAKES THE WHEELS GO 'ROUND?

Public sentiment, backed by low prices and thoroughly good lamps, give us orders to run every day in the year and a great many of the nights. The trust factories go by fits and starts, or rather stops, which we can only account for in two ways—either they try to sell their lamps for too high a price, or they are of poor quality, or possibly both.

We will be right here making high grade lamps at fair prices when the Lamp Trust is a thing of the past. We solicit your orders on the above basis. Can't you support such a position? If so, send your orders to

The Warren Electric & Specialty Co.,

MANUFACTURERS HIGH GRADE ANTI-TRUST INCANDESCENT LAMPS,

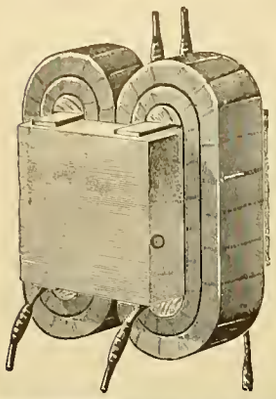
Warren, Ohio.

PRICES AS FOLLOWS:

10, 16 and 20 C. P. lamps, barrel lots, capped with Edison or Westinghouse bases, 17c. T.-H., Brush-Swan, U. S. and Hawkeye bases, 1c extra. Schaeffer and Perkins bases, 3c extra.

Mention the WESTERN ELECTRICIAN.

Transformers (SCHEEFFER'S IMPROVED) Wattmeters.

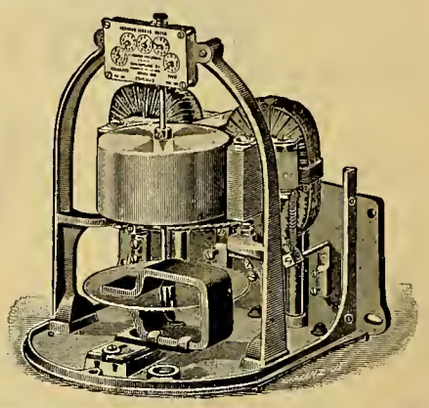


Double Primary Coils,
Double Secondary Coils,
Good Ventilation,
Light Weight,
High Efficiency,
Good Regulation,
Small Iron Loss.

Convenient to Install.

No Brushes,
No Commutator,
No Moving Wire,
Simplicity,
Durability,
Reliability,
Accuracy,

Even to a 6 c. p. Light.



DIAMOND ELECTRIC CO.,
Manufacturers,

Office:
1202 Fisher Bldg.,
CHICAGO, ILL.

Factory:
PEORIA, ILL.

NON-ARCING AUTOMATIC CIRCUIT BREAKERS
GUARANTEED TO OPERATE PERFECTLY OR NO PAY. MADE FOR ALTERNATING OR DIRECT CURRENT. ANY VOLTAGE. CATALOGUE FREE.
AUTOMATIC CIRCUIT BREAKER COMPANY, NEWAYGO, MICHIGAN, U. S. A.

NEW HART FLUSH SWITCHES

IN GANGS OF ANY NUMBER.

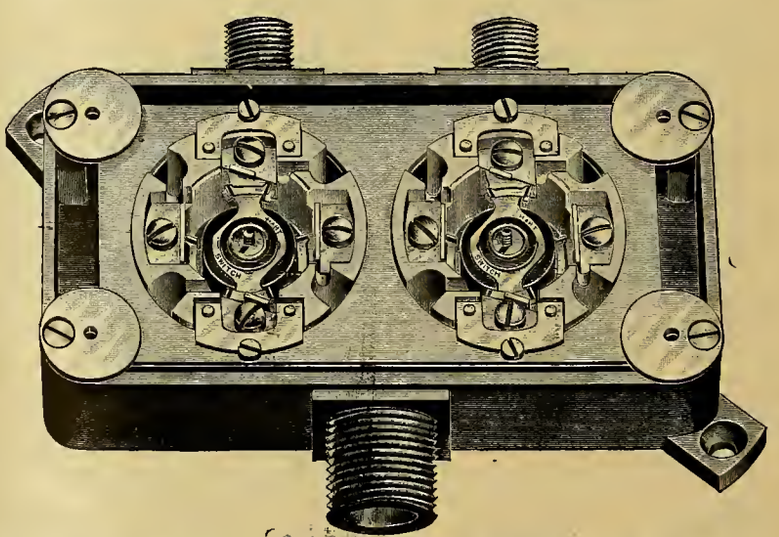
THE SWITCHES ARE INSERTED AND CONNECTED UP FROM THE FRONT.

FLUSH SWITCH FOR GANGS.

The Cut shows a No. 2 Box for iron armored conduit, with a gang of two switches.

The boxes are furnished with any number of outlets desired.

Switches are "Indicating."



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HARTFORD, CONNECTICUT.

IF you are anxious to secure the latest electrical books, **YOU** should write to the ElectricianPublishing Co., Chicago. You **CAN'T** procure too many reliable, readable books to **READ.**

WESTERN ELECTRIC CO.
CHICAGO. **SUPPLIES**

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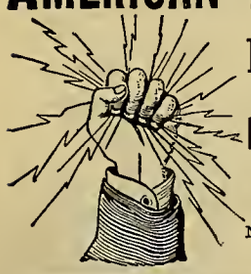
AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



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INCANDESCENT AND FLEXIBLE CORDS,

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AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.

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CHICAGO STORE, F. E. Donohoe, 241 Madison St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.

THE ONLY

WATER-WHEEL GOVERNOR

THAT GOVERNS.

WATERVILLE & FAIRFIELD RAILWAY & LIGHT CO.,
WATERVILLE, ME., Jan. 18, 1896.

Lombard Water-Wheel Governor Co., Boston, Mass.

GENTLEMEN:—In regard to your Type C governor, which is regulating for us our two Hercules Wheels, which give power to operate our Light Plant, Street R. R. and Power Generator, we are frank to admit that the machine does its work admirably. We have no hesitancy in recommending it to those in want of a governor.

(Signed)
I. C. LIBBY, President Waterville & Fairfield R. R. & L. Co.

LOMBARD WATER-WHEEL GOVERNOR CO.,

61 Hampshire St., BOSTON, MASS.

TRIMMER'S TOWER WAGON.

NOVEL FEATURES.

With it a Trimmer can trim about 250 lamps as compared with 60 lamps trimmed by "trudging with ladder and kit." Write for detailed description.

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No Sparking Under Varying Load,
No Wear on the Commutator.

90% PURE GRAPHITE.

Holmes Fibre-Graphite Mfg. Co.,

Station Z, Philadelphia.

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Apparatus for

Arc, Direct Current and Alternating Incandescent Lighting and Power Transmission.

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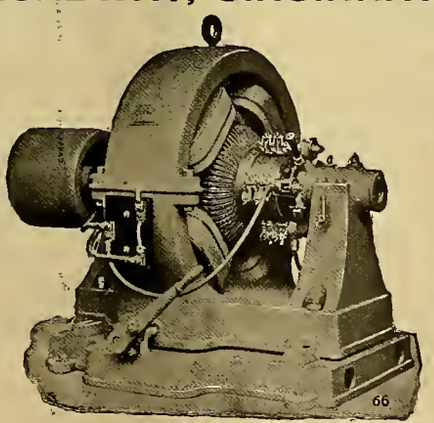
ELECTRIC LIGHT AND POWER PLANTS, AND SLOW SPEED MOTORS.



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"AMERICAN" STORAGE CELLS
ARE THE BEST. Send for Descriptive Circular.
Absolutely Non-Infringing.
Protection Guaranteed.
AMERICAN BATTERY CO.,
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EVERYTHING IN WIRE.

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St. Louis Electrical Supply Co., St. Louis.
The Bradford Belting Co., Cincinnati

Phillips Insulated Wire Co.,

Office and Factory: PAWTUCKET, R. I.

WANTED.

A man competent to manage an electric repair shop. Must be a good mechanic himself and have a fair technical education. One who is familiar with switchboard work or can develop the manufacture of special appliance preferred. State age and experience. Address "REPAIR," care WESTERN ELECTRICIAN, 510 Marquette Bldg., Chicago.

WANTED.

Position by a young man with a thorough technical education and wide practical experience; where there is some chance for advancement, where ability, brains and hard work will be appreciated and rewarded. Address "E. E.," care WESTERN ELECTRICIAN, 510 Marquette Bldg., Chicago.

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Position as superintendent or chief engineer of power or electric light plant, by a man of experience and college education. I can give best reference as to ability and character. Would be pleased to hear from parties wanting an A1 man. Address "POWER," care WESTERN ELECTRIAN, 510 Marquette Bldg., Chicago.

WANTED.

Situation as manager or assistant manager or inspector of some independent telephone company by man experienced as manager and inspector, also as foreman of outside construction. Best references furnished. Address "Telephone Mgr.," care WESTERN ELECTRICIAN, 510 Marquette Bldg., Chicago.

WANTED.

ARMATURES TO REWIND.

Winders direct from T.-H. and Westinghouse shops. Work guaranteed. Ten years' experience. Light plants installed complete. Send for prices.

HODGE, WALSH & LORING,
531 Delaware. KANSAS CITY, MO.

FOR SALE.

Thirty 20 ampere Shallenberger recording ampere-hour meters, practically new; very cheap. These meters are guaranteed to be equal in accuracy and sensibility to new meters. Address "X. Y. Z.," care WESTERN ELECTRICIAN, 510 Marquette Bldg., Chicago.

FOR SALE.

Rare opportunity for investment and for business. The whole or a controlling interest in the stock of the St. Paul and Suburban Railway Company will be sold at a very low figure. This company owns and operates an electric line of railway from St. Paul to White Bear Lake, and owns a summer resort on the lake. This is a valuable property and will bear investigation. No bonded or other indebtedness. Full particulars and description will be given upon application to E. W. PEET & SON, Manhattan Bldg., St. Paul, Minn.

FOR SALE CHEAP.

Make us an offer. One iron mast standing, complete, 125 feet high, second hand, for 4 lamps, in good state of preservation; having no further use for it we are anxious to sell. Santa Barbara Electric Light Co., Santa Barbara, Cal.

FOR SALE.

Second hand Arc Lamps of different manufacture; good as new and thoroughly tested: also, Arc and Incandescent Dynamos and other electrical apparatus.

Always in the market for scrap Dynamos, Motors, Wire, Copper, burned out Incandescent Lamps and Lamp bases, etc. Address THE CORNMAN COMPANY, 1134 Hamilton St., Cleveland, Ohio.

Bargains in Street Railway Apparatus.

MOTORS.

	Price each.
4 G. E. 800 motors	$185.00
2 Steel motors, "C" No. 3	200.00
4 Walker motors, 30 h. p.	175.00
2 Westinghouse No. 12, 30 h. p.	150.00
10 " No. 12, 20 h. p.	160.00
23 " No. 3, 25 h. p.	150.00
24 Edison No. 6, 15 h. p.	65.00

GENERATORS.

Edison, T.-H., Detroit, Rae. Write for prices.

TRUCKS.

20 McGuire old style trucks, 25 Brill trucks, Cars and Trailers. Write for photos and prices.

The Electrical Exchange,
Long Distance Tel. 744 Express.
166-174 S. Clinton St., Chicago.

NOTICE TO BIDDERS.

Notice is hereby given that bids will be received by the Common Council of the City of Niagara Falls up to and including the first day of November, 1897, at 8 o'clock p. m., for the exclusive furnishing of electric arc lights to the City of Niagara Falls for a period of five years from November 1, 1898, according to specifications on file with the city clerk.

Each bid shall give the name and address of the bidder and shall state the price per annum for which the bidder will furnish each electric arc light of a two thousand (2,000) candle lamp power for said term.

The estimated number of arc lights to be furnished is three hundred (300) with the right of the Common Council of the said city to increase or decrease the said number as it may elect during said term.

The successful bidder will be required to enter into contract for the furnishing of such number of electric arc lights as may be required for such term at the price per annum named in its bid and to furnish bond in twenty thousand dollars ($20,000) for the faithful performance of said contract.

Each bidder must accompany his bid with a certified check for ten thousand dollars ($10,000) as a guarantee that he will enter into contract if the same is awarded to him.

Further information, if desired, will be furnished by the city clerk upon application.

All bids shall be opened at the meeting of the Common Council to be held Monday, November 1, 1897.

The Common Council reserves the right to reject any or all bids.

Dated August 16, 1897.

By order of the Common Council.
S. F. ARKUSH,
City Clerk.

PROPOSALS FOR

LIGHTING.

OFFICE OF THE CITY CLERK.

Proposals for lighting the streets of the city of Lorain, Ohio.

Sealed proposals will be received at the office of the City Clerk in the Wagner building until Sept. 6, 1897, at 12 o'clock noon, for the lighting, furnishing, extinguishing and keeping in repair, including the furnishing of glass and all materials necessary therefor, for 50 electric lamps more or less, of 1,200 or 2,000 candle power each. Also for the lighting, furnishing and extinguishing and keeping in repair of such number of gas or vapor lamps as will be equivalent to 50 electric lamps of 2,000 candle power each, and the furnishing of poles and other equipments therefor for a period of five years and ten years alternating bids.

Specifications can be seen at the office of the City Clerk.

Each proposal must contain the full name of the party or parties making the same, and all persons interested therein, and must be accompanied by a five-hundred-dollar certified check on a solvent bank in the city as surety that if the proposals be accepted a contract will be entered into.

No proposals will be entertained unless delivered at the office of the city clerk in the Wagner building by 12 o'clock noon, Sept. 6, 1897.

The city reserves the right to reject any and all bids.

G. A. RESEK, City Clerk.

A. L. McRAE, CONSULTING ELECTRICAL ENGINEER.
Estimates, Plans, Specifications, Examinations, Reports, Tests.
306 Oriel Building, ST. LOUIS, MO.

Scrap Copper Wire Wanted.

If you have any **Old Copper Wire** of any description to dispose of, it will pay you to communicate with us, as we are at all times in the market for any quantity of **Scrap Copper Wire**, at the highest market values. We pay cash and send prompt returns. We are also supplying the electrical trade with our high grade **Babbitt, Cotton Waste, Solder, Etc.** Please communicate with us.

SWARTS METAL REFINING CO.,
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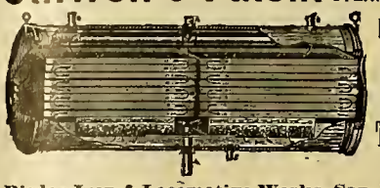
Stilwell's Patent LIVE STEAM-FEED Water Purifier.



Removes all Impurities.
ENTIRELY PREVENTS SCALE IN STEAM BOILERS. Catalogue on Application.
The Stilwell-Bierce & Smith-Vaile Co.,
DAYTON, OHIO.
Risdon Iron & Locomotive Works, San Francisco, Cal., Pacific Coast Agent.

BIDS WANTED.

The city of Asheville, N. C., desires bids for furnishing and maintaining one hundred to one hundred and fifty electric arc lights of two-thousand (2,000) candle power each.

The city reserves the right to reject any or all bids. Bids to be received until Sept. 20, 1897.

GEO. F. SCOTT, Chairman,
Special Light Committee,
Asheville, N. C.

Repairs--Chicago

ARMATURES, FIELDS, COMMUTATORS.
TELEPHONE MAIN 1120.

J. E. EISELE,
94 Lytle Street.

Agents Wanted.

A few good live agents to take subscriptions for the WESTERN ELECTRICIAN and handle our book publications. Liberal commissions paid.

Address, stating experience and references,

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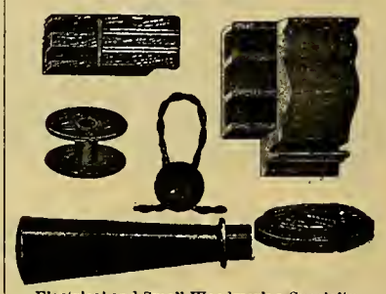
The Brady Mast Arms.
T. H. Brady, New Britain, Conn., U. S. A.,
Manufacturer of Mast Arms, Pole and Swinging Hoods, House Brackets and other Specialties for Construction Work.—*Catalogues and Prices furnished on application.*

Anchor or Toggle Bolt.

PATENTED OCT. 29, 1895.
TENSILE STRENGTH, 870 LBS.



Electrical and Small Woodwork a Specialty.
Send for catalogue.
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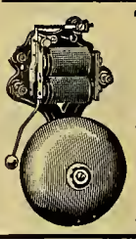
Engineers and Contractors for Electric Power Stations.
Sole owners of patents controlling the "ARNOLD SYSTEM" of power station construction.
Reduction in first cost, economy and greater reliability in operation. Write for information.



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STYLE "F"
3 TO 15 INCHES.
ASK FOR IT.
SEND FOR CATALOGUE.
HUEBEL & MANGER,
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290 Graham St., Brooklyn N. Y.

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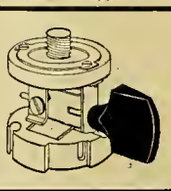

Write for full particulars, free Samples, etc. We make many brands of

SOCKETS

Have saved others money. Can save you.
H. T. PAISTE CO.
CHICAGO PHILADELPHIA

New Dynamo Tenders' Hand-Book.

By F. B. BADT.

226 Pages, 140 Illustrations. Flexible Cloth Binding. Size of Type Page 5 1-2x3 inches. Price $1.00.

This is, as the name indicates, a NEW BOOK, much more complete than the old one, with all the information, instructions and rules which are required by practical men, as Dynamo Tenders, Linemen, Stationary Engineers, and owners and operators of all kinds of Electric Plants. It is the only book of the kind published in the English language. 9,000 copies of the old Dynamo Tenders' Hand-Book sold, and over 5,000 of the new.

Electrician Publishing Co.,
510 Marquette Building, CHICAGO.

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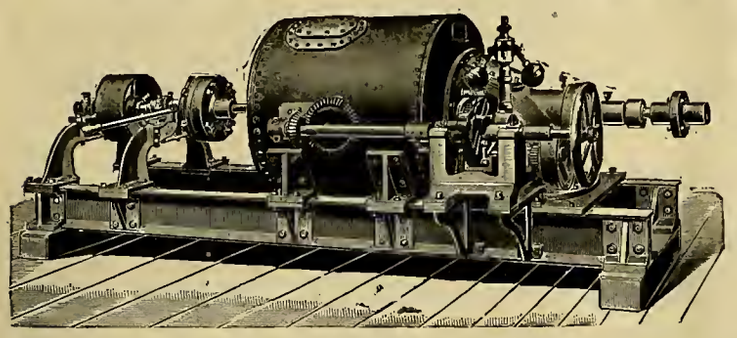
14-16-18 MIDDLE ST.
CLEVELAND-O.

Victor Turbine Water Wheel.



Cylinder or Register Gate—Close Regulation and High Efficiency at Full and Partial Gate.

The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high speed and great efficiency and large capacity** for its **diameter,** being **double** the **power** of most wheels of the same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

The accompanying engraving represents a single 10-inch Victor Turbine on horizontal shaft to develop 36 H. P. under 38 feet head. Arranged with 12-inch Worrell Friction Coupling at one end to disconnect pulley.

We are now prepared to furnish Victor Turbines, either single or in pairs, on horizontal shafts, and where the situation admits of their use we recommend them.

THE STILWELL-BIERCE & SMITH-VAILE CO., DAYTON, OHIO.

Risdon Iron & Locomotive Works, San Francisco, Cal., Pacific Coast Agents.

WHITE CEDAR POLES And STREET CAR TIES. Wholesale Producers.
PERRIZO & SONS, DAGGETT, MICH.

CEDAR LINDSLEY BROS., MENOMINEE, MICH., WHOLESALE PRODUCERS. **POLES**

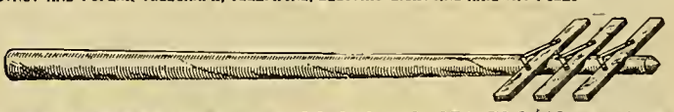
Ira Carley Can ship you anywhere anything in cedar from a 3 in. 7 ft. to 7 in. 70 ft. **Electrical contracts my specialty.**
INCALLS, MICH.

CEDAR Telegraph, Telephone, Railway and Electric Light **POLES**
A. J. McLEAN, Menominee, Mich.

Point Marion Mfg. Company,

Office: 430 Fourth Avenue, PITTSBURG, PA.

CHESTNUT AND POPLAR TELEGRAPH, TELEPHONE, ELECTRIC LIGHT AND RAILWAY POLES



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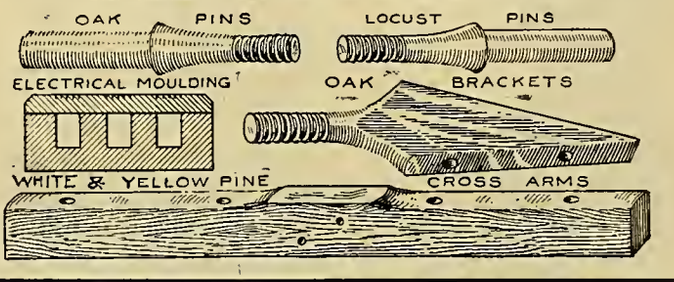

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CHICAGO ELECTRO. & STEREO. CO.,
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TROLLEY POLES.

National Tube Works Company.

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Chicago, corner Clinton and Fulton Streets.
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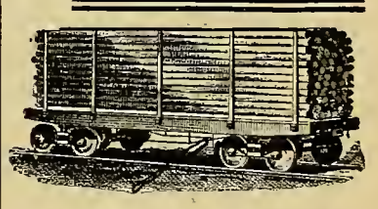
POLES.



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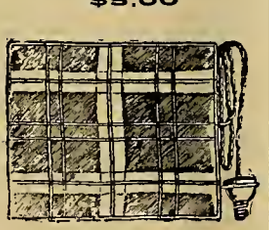

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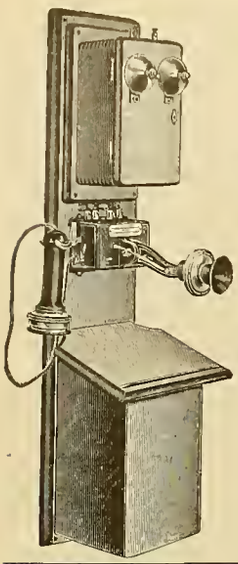

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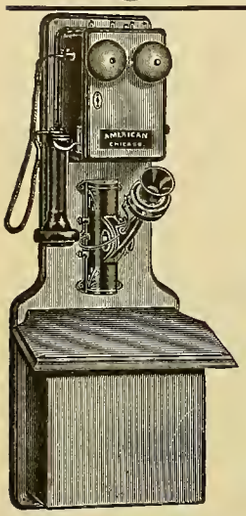

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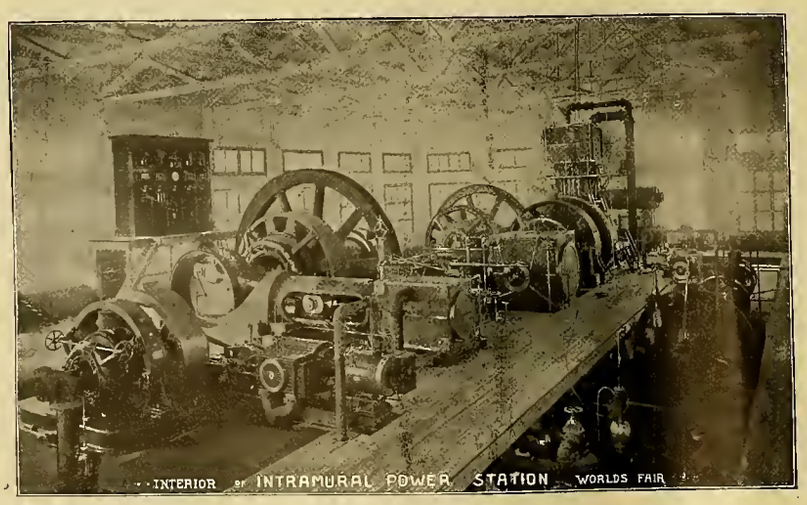

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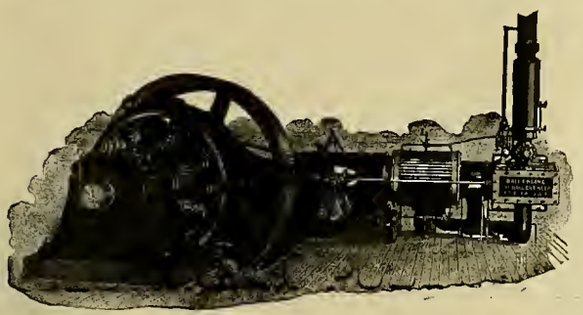

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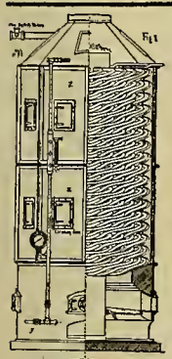

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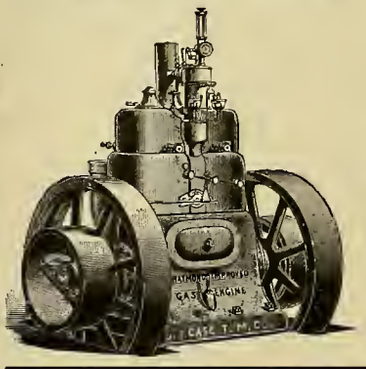

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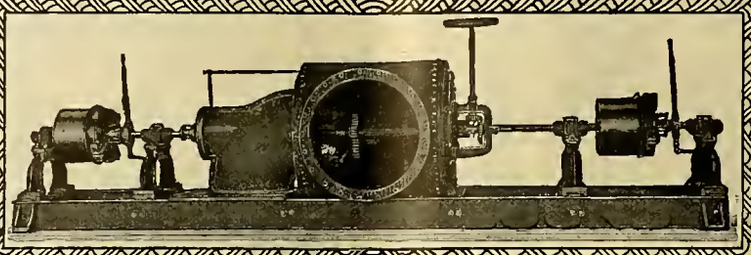

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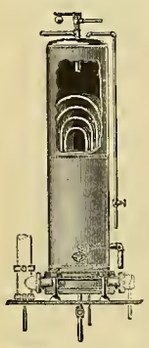

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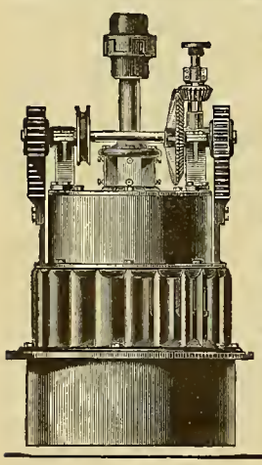

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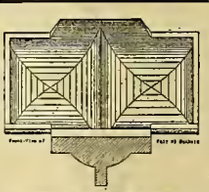

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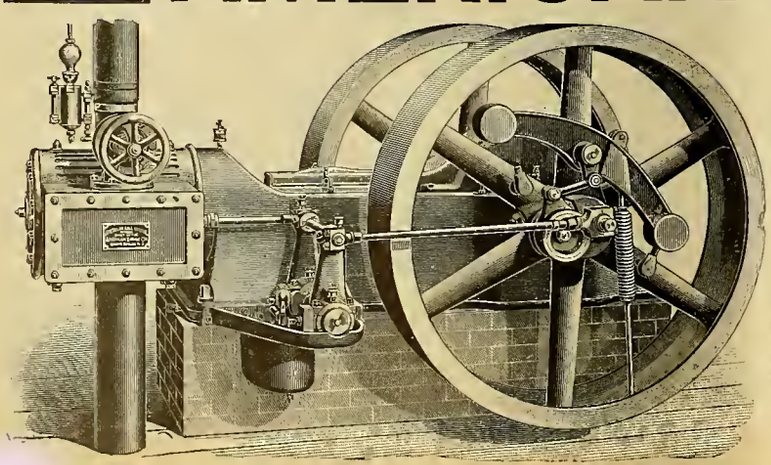

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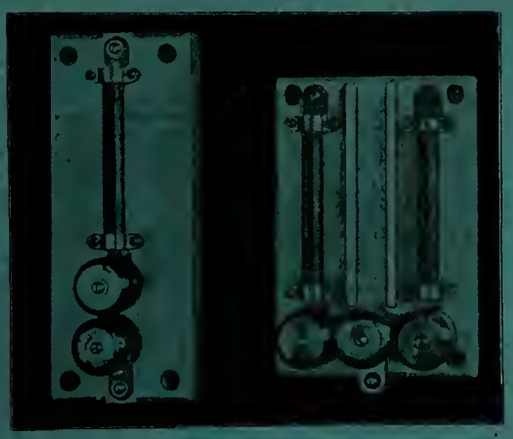

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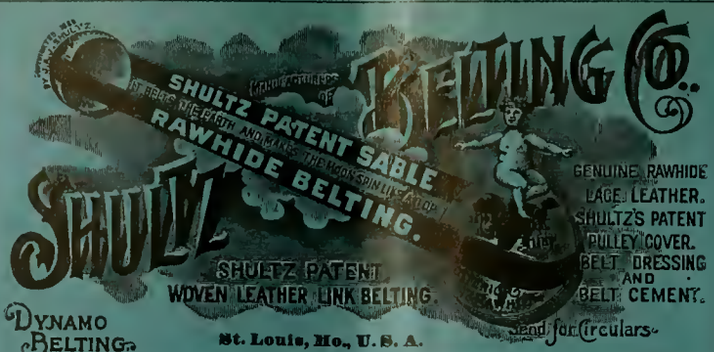

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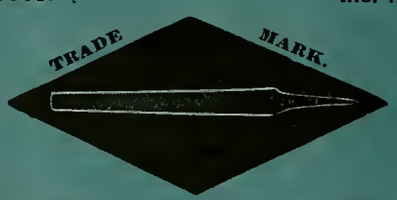

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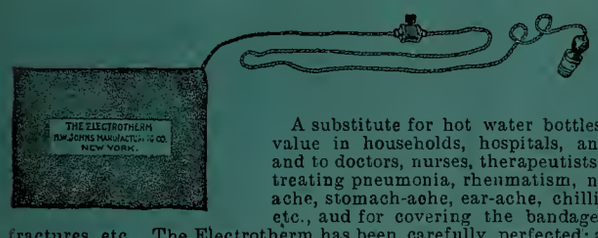

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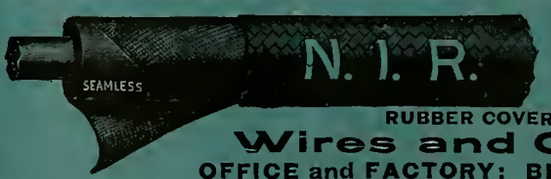

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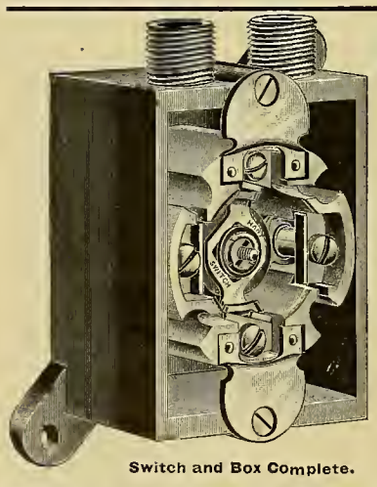

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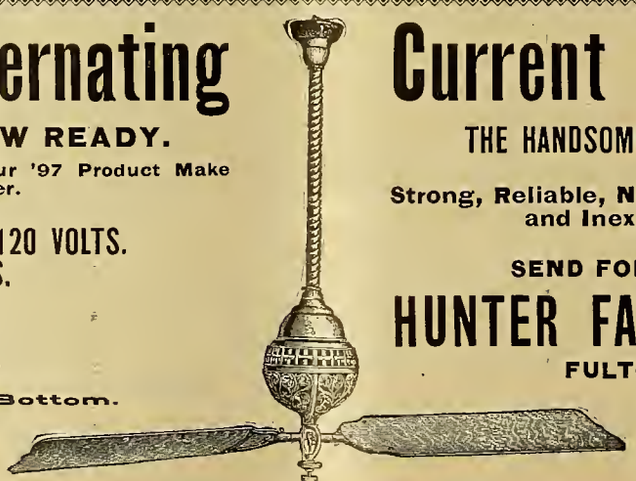

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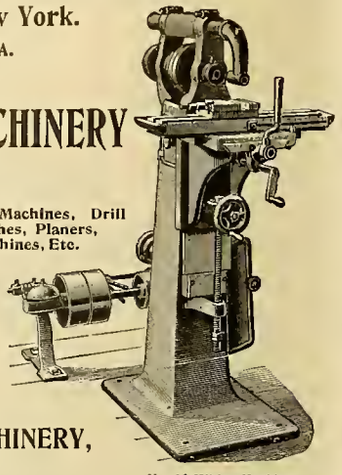

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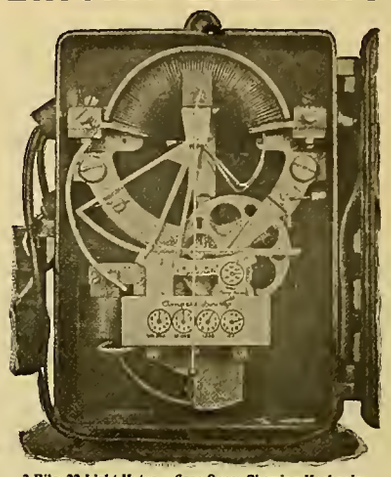

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Western Elec. Co.
Westinghouse El. & Mfg. Co.

Feed Water Heaters.
Davis & Son, I. H.

Fibre.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.
Central Electric Co.

Fixtures, El. & Comb'n.
Central Electric Co.
Commercial El. Supply Co.

Fuses.
D. & W. Fuse Co.

Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg.Co.
Commercial El. Supply Co.
Electric Appliance Co.

Gaskets.
Johns, H. W., Mfg. Co.
Peerless Rubber Mfg. Co.

Gas Lighting, Electric.
Central Electric Co.

Gears.
Besly & Co., Chas. H.
Central Electric Co.

General Elec. Supplies.
Besly & Co., Chas. H.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
General Electric Co.
Hill, W. S. Electric Co.
Hodge, Walsh & Loring.
Ohio Electric Works.
Paiste Co., H. T.
Partrick & Carter Co.
Peoples Electric Co.
Peru Elec. Mfg. Co.

Globes and Electrical Glassware.
Central Electric Co.
Commercial El. Supply Co.

Gov'nors, Water Wheel.
Lombard Water Wheel Gv. Co.

Graphite Specialties.
Besly & Co., Chas. H.
Central Electric Co.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Induction Coils.
Central Electric Co.
Queen & Co.

Insulators and Insulating Materials.
Brixey, W. R.
Bryant Electric Co.
California Asphalt Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
Emerson El. Mfg. Co.
Empire China Works.
Hill, W. S. Electric Co.
Hodge, Walsh & Loring.
Johns Mfg. Co., H. W.
Mica Insulator Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Paiste Co., H. T.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

Lamp Adjusters.
Vought, M. I.

Lamps, Incandescent.
Buckeye Electric Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
General Electric Co.,
Lynn Incandescent Lp. Co.
Ohio Electric Works.
Sawyer-Man Elec. Co.
United Elec. Imp. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamp Trim'r's Wagons.
Studebaker Bros. Mfg. Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Westinghouse El. & Mfg. Co.

Magnet Wire.
(See Insulated Wires.)

Mechanical Machinery.
Besly & Co., Chas. H.
Garvin Machine Co., The.
Stilwell-Bierce Smith-Vaile.

Mica.
Central Electric Co.
Commercial El. Supply Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
General Electric Co.
Westinghouse El. & Mfg. Co.

Motors.
Ahlm-Edwards Elec. Co.
American Engine Co.
Belknap Motor Co.
Brush Electric Co.
Bullock Elec. Mfg. Co.
Card Electric Co.
Central Electric Co.
Commercial El Supply Co.
Crocker-Wheeler Elec. Co.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Keystone Electric Co.
Muir & Son, Thos.
Northern Electl Mfg. Co.
Ohio Electric Works.
Peoples Electric Co.
Scott & Janney El. & Mfg. Co.
Stanley Elec. Mfg. Co.
Storey Motor & Tool Co.
Triumph Electric Co.
United Elec Imp. Co.
Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co

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Besly & Co. Chas. H.
Garlock Packing Co.
Johns, H. W., Mfg. Co.
Peerless Rubber Mfg. Co.

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Central Electric Co.
Commercial El. Supply Co.
Johns. H. W. Mfg. Co.

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Besly & Co., Chas. H.
Phosphor Bronze Sm. Co. Ltd.

Platinum.
Baker & Co.

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Carley, Ira.
Lindsley Bros.
McLean, A. J.
National Tube Works Co.
Northern Supply Co.
Parrize & Sons.
Point Marion Mfg. Co.
Sterling & Son, W. C.

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Central Electric Co.
Commercial El. Supply Co.
Empire China Works.
Peru Elec. Mfg. Co.

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Commercial El. Supply Co.
Electric Appliance Co.
Emerson El. Mfg. Co
Partrick & Carter Co.

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Swarts Metal Refining Co.

Reflectors.
Muir & Son, Thos.

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Central Electric Co.
Chicago Edison Co.
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Elliott, W. H. Elec. Co.
Hodge, Walsh & Loring.

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Am. El. Heat. Corporation.
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Muir & Son, Thos.
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Cornman Co.
Electrical Exchange, The.
Elliott, W. H. Elec. Co.

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Central Electric Co.
Muir & Son, Thos.

Speaking Tubes.
Central Electric Co.
Electric Appliance Co.
Partrick & Carter Co.

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Central Electric Co.
Keystone El. Instrument Co.
Queen & Co.
Weston Electrical Inst. Co.

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National Tube Works Co.

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Central Electric Co.
Electric Storage Battery Co.
N. Y. Accum. & Electric Co.
Ohio Storage Battery Co.
Willard El. & Battery Co.

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American Electrical Works.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Moore, Alfred F.
New York Insulated Wire Co
Okonite Co., The.
Simplex Electrical Co.
Washburn & Moen Mfg. Co.

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Climax Novelty Co.
Commercial El. Supply Co.
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Lockwood T. & T. Co. of Am
Mo. Tel. Mfg. Co.
Orne Elec. Cons. Co.
Peoples Electric Co.
Standard Tel. & El. Co.
Stromberg-Carlson Tl. M. Co.
Taber & Mayer.
Viaduct Mfg. Co.
Western Tel. Cons. Co.

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Central Electric Co.
Commercial El. Supply Co.
Diamond Elec. Co.
Ft. Wayne Elec. Corporation
General Electric Co.
Stanley Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

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Central Electric Co.
Samson Cordage Wks.

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Brill Co., J. G.
General Electric Co.
Westinghouse El. & Mfg. Co

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Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Wire, Bare.
Besly & Co., Chas. H.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co
Standard Underground C Co
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Central Electric Co.
Commercial El. Supply Co.
Queen & Co.

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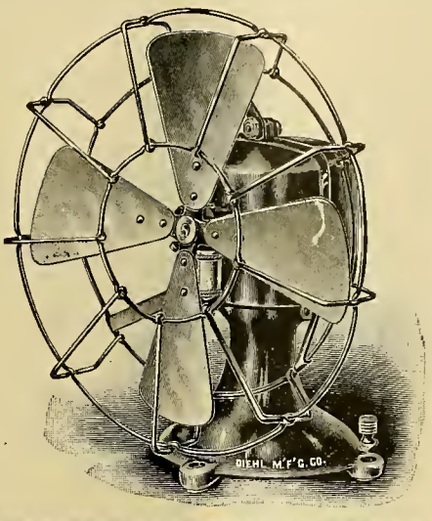
Ceiling Fans and Exhaust Wheels

Wound for Any Current, Except Alternating.

Our Exhaust Wheel Combinations

Are the most compact and efficient made.
Write for catalogue and prices.



Propeller or Desk Fans

Wound for 110, 220 or in series on 500 volts.
Also for Primary or Secondary Battery Circuits.

Highest Efficiency

Unbroken Magnetic Circuit, Self-Aligning Bronze Bearings. Finest Insulation Throughout. Four-Speed Regulator.

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THE BEST ANSWER TO A QUESTION

On Wiring, can be found in the New Book,

"WIRING TABLES,"

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BY THOS. C. CRIER.

Whenever you are asked a question on Wiring, refer the questioner to this book, and he will find what he desires.

THE BOOK CONTAINS: The Law of Resistance, Electromotive Force and Current Fully Explained. How to Calculate the Size of Wires. The Different Methods of Wiring, with Diagrams. How to Apply the Simple Formula, in Calculating the Size of Wires Under all Conditions. Diagrams for Wiring 3 Point, 4 Point, Head Light and Heat Regulating Switches.
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Ohm's law is described in such plain and simple language that one cannot fail to clearly understand it.

Bound in Cloth, 80 Pages, Size 5x7½ In. Sent, prepaid, on receipt of price, $1.00.

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Generators, Motors, Transformers, for Two-Phase, Three-Phase and C. F. Scott Two-Phase Three-Phase System of Alternating Current Power Transmission.

26,000 H. P. IN OIL-INSULATED TRANSFORMERS CONSTRUCTED.

Potentials from 5,000 to 50,000 Volts. All Apparatns Necessary for 100 Mile Transmission.

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San Francisco, Mills Bldg.
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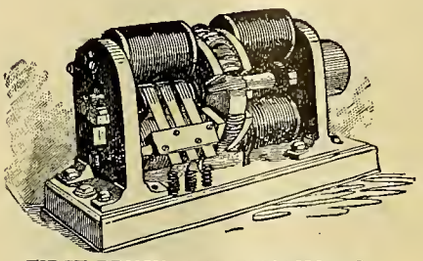
Atlanta, Ga., Equitable Bldg.
Westinghouse Electric Co., Ltd., 32 Victoria St., London, S. W., England.
For Canada address Ahearn & Soper, Ottawa, Ont.

THE BRUSH ELECTRIC COMPANY.

BRUSH

THE BRUSH ELECTRIC COMPANY.

Brush apparatus has been on the market for 20 years. A majority of customers order supply parts direct from us. Many do not. We want this trade and are reducing our prices in order to secure it. Ask for quotations and send orders to the nearest Sales Office.



FIRST BRUSH ARC DYNAMO—1877

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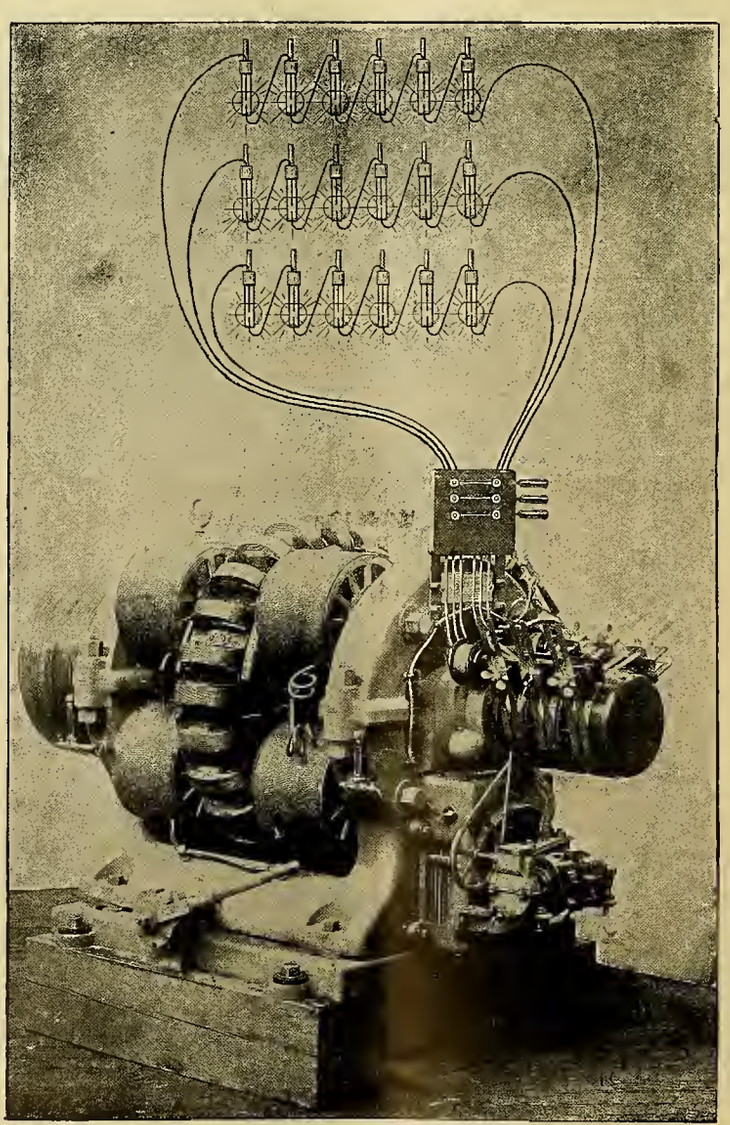
Cleveland, Ohio.
Boston, Mass., 180 Summer Street.
New York, N. Y., 44 Broad Street.
Philadelphia, Pa., 509 Arch Street.
Cincinnati, Ohio, 420 West Fourth Street.
Chicago, Ill., Monadnock Building.
St. Louis, Mo., Wainwright Building.
Atlanta, Ga., Equitable Building.
Denver, Colo., Kittredge Building.
San Francisco, Cal., 15 First Street.
Toronto, Ont., Canadian General Electric Co., Ltd.
Pittsburg, Pa., Carnegie Building.

Many stations have exchanged all their small units for large Brush arc dynamos. Among them are the Brooklyn-Citizens with 3000 lights capacity. Brooklyn-Municipal 800, Newark 3000, Cleveland 1800, Philadelphia Brush 1500, Philadelphia-Northern 1300, Buffalo 1500, Worcester 1400, Toronto 900, Quebec 625, Harrisburg 750, Erie 750, Albany 500, Troy 500, Paterson 500, City of Chicago 400, John Wanamaker 625, Carnegie Steel Co. 500.



BRUSH MULTI-CIRCUIT 125 LIGHT ARC DYNAMO—1897.

Over 40,000 lights capacity in large Brush arc dynamos sold. A large proportion of them using Multi-Circuit Dynamos.

The newly designed Brush dynamos have the following capacities; 55, 80, 100, 125, 240, 300, 2000 candle-power lights, 45, 85, 120, 160, 1200 candle-power lights.

Brush arc lamps were first used in 1877. More of them being sold to-day than ever before.

Two or more separate circuits run direct from one dynamo with any distribution of load on the different circuits. The advantages are absolute flexibility in handling of circuits; reduction of high voltages on circuits run from large dynamos; use of large units with corresponding increase of efficiency; saving in floor space, oil, belts, shafting, pulleys, attendance.

TRADE MARK:
"Chloride Accumulator"
REGISTERED SEPTEMBER 11, 1894.

THE CHLORIDE ACCUMULATOR Is Most Extensively Used Where It Is Best Known.

A DUPLICATE of the battery of **CHLORIDE ACCUMULATORS** installed in the United States Custom House, New York, a year ago, has just been contracted for; it will carry the night lamps in the Sub-Treasury and Assay office, and during the day, in connection with the original battery, it will regulate in the electric elevator service in the Custom House.

CATALOGUES.

The Electric Storage Battery Co.,
Drexel Bldg., Philadelphia, Pa.

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GREATER THAN KLONDIKE!

The *New York Daily World* says:

Greater than Klondike.

Dollar wheat in the market means 60-cent wheat on the farm. Sixty-cent wheat on the farm means that the wheat farmers of the United States will receive just about $300,000,000 for their crop of 1897. Three hundred millions is a huge sum. For the wheat farmers of the country it lays the broad foundation of a real prosperity. A three-hundred-million-dollar wheat crop is indeed a splendid piece of cereal wealth. This golden nugget from the wheat field is a whole Klondike in itself.

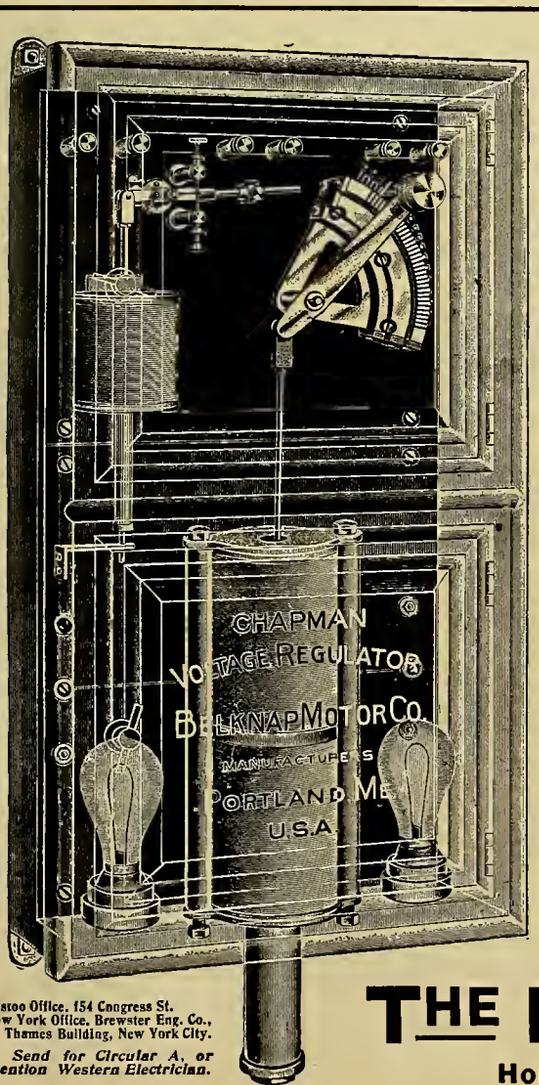
AD. STUDIO

COMMERCIAL ELECTRICAL SUPPLY CO.,

ST. LOUIS.

P. S.—Business is steadily picking up. Do you realize that now you can buy supplies cheaper than ever before? Why not lay in your stock **now** and at **"bottom."**

P. S.—Catalogue? Why not?



Steady Lights from Unsteady Power.

The Chapman Voltage Regulator

Controls the voltage of varying speed dynamos.

Lamp renewals reduced.

Perfect regulation of voltage by an automatic device magnetically controlled. 25 to 50 per cent. variation in speed of water wheel or engine controlled within 2 per cent. of the normal, and it acts as quick as a circuit breaker. Every central station should have them. Generators can be worked nearer the limit of their capacity by their use, thus increasing their effective working power.

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Glen Mfg. Co., Berlin, N. H.
Rumford Falls Sulphite Co., Rumford Falls, Me.
Northfield Electric Co., Northfield, Vt.
Hollingsworth & Whitney Co., Waterville, Me.
Bar Mills Electric Co., Bar Mills, Me.
Forest Mills Co., Bridgton, Me.
Norway Electric Light Co., Norway, Me.
Crookston Water, Pr. & Lt. Co., Crookston, Minn.
Pondicherry Mills, Bridgton, Me.
Kingston Electric Co., Philadelphia, Pa.
Burgess Sulphite Co., Berlin, N. H.
Cliff Paper Co., Niagara Falls, N. Y.
Westbrook Electric Light Co., Westbrook, Me.
Valleyfield Electric Co., Valleyfield, Quebec.
Orr & Co., Paper Mills, Troy, N. Y.

Recent orders have just been received from Stanley Electric Mfg. Co., Pittsfield, Mass.; Calumet & Hecla Smelting Co., So. Lake Linden, Mich.; Edison Elec. Ill'g Co., Topeka, Kan.; Marietta Elec. Co., Marietta, O., and Westbrook Elec. Lt. & Pr. Co., Westbrook, Me.

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Is Still Made and Sold by Us.

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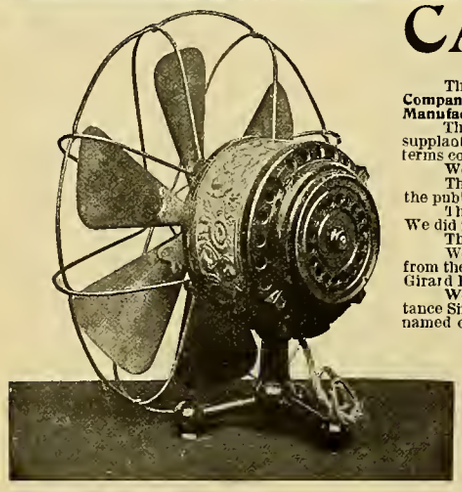

CARD TO THE PUBLIC.

The **General Electric Company, Westinghouse Electric Company, Thomson-Houston Electric Company** and the **Tesla Electric Company** have brought suits against the **Scott & Janney Electric & Manufacturing Company** for "alleged infringements" of their various patents.

This is the **USUAL "BLUFF"** that is brought to bear upon those whose inventions are bound to supplant the inventions of the above named and other large electrical concerns, who cannot at their own terms control such new inventions.

We are manufacturing under **our own patents** and **are not infringing.**

The above named firms are suing us upon a small fan motor as an excuse to get a chance to make the public believe that the state of the art is not history as far as they know it.

They have spent millions of dollars trying to invent apparatus to do certain things. They failed. We did invent it and have had it patented all over the world. **AND IT WORKS.**

They will try by strategy to do what they dare not do openly.

We wish to ask that the dealers and others who have received or will receive threatening letters from the above named concerns, will please send same to our attorneys, Messrs. Alexander & Magill, Girard Building, Philadelphia.

We are in the field to stay and do not propose to be intimidated. The Scott & Janney Long Distance Single Phase Alternating Railway and Power System will supersede the inventions of the above named companies. **AND THEY KNOW IT.**

FULL PROTECTION GUARANTEED TO ALL PURCHASERS OF OUR APPARATUS.

The Scott & Janney Electric and Mfg. Co.,

1707-1709 Filbert Street, PHILADELPHIA.

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QUALITY UNEQUALED

FACTORY PRODUCTION TRIPLED.

INCANDESCENT LAMPS.

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NEW DYNAMO TENDERS' HAND-BOOK.
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ELECTRIC TRANSMISSION HAND-BOOK.
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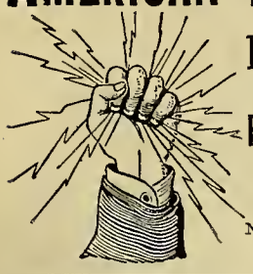
CHICAGO. **SUPPLIES**

EUGENE F. PHILLIPS, Prest. F. N. PHILLIPS, Treas. W. H. SAWYER, Secy.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



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ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,

Railway Feeder and Trolley Wire,

AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.

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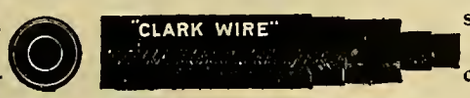
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.

THE "CLARK" WIRE.

FOR SWITCHBOARD, RAILWAY and MOTOR USE.



All sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

Inspector Boston Fire Underwriters' Union says:
"A thoroughly reliable and desirable wire in every respect."

The Clark wire has been before the public and in use for the past ten years, and has met with universal favor. We guarantee our insulation wherever used. Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first-class insulated wire. We shall be pleased to mail Catalogues, with terms and discounts for quantities.

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HERBERT H. EUSTIS, Pres. and Electrician.

61-63 Hampshire Street,
BOSTON, MASS.

TRIMMER'S TOWER WAGON.

Highly Endorsed.

Studebaker Bros. Mfg. Co.

Gentlemen:—In reply to your inquiry as to the advantage in the use of Light Tower Wagons, which you constructed by my request, to be used in trimming the arc lamps which are distributed throughout the parks and boulevards of the West Chicago park system, I will say that we have purchased six of these wagons and they have proven to be everything anticipated. I have had two trimmers taking care of 600 arc lamps per day of eight hours. The trimmers would trim and clean the lamps and keep them in satisfactory condition without any difficulty, and this has been done when the thermometer was below zero. In the use of the wagon on smooth roads it is not necessary to have an extra driver, the horse soon becomes so well trained that he will stop before each lamp pole by a simple command from the trimmer. I consider the Tower Wagon, as a means of trimming arc lamps, to be much cheaper than the old way of trimming by the use of ladders.

Yours truly, FOREE BAIN.

Chicago, July 6, 1897.

Write for detailed description.

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SOUTH BEND, IND.

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Apparatus for

Arc, Direct Current and Alternating Incandescent Lighting and Power Transmission.

The Bullock Electric Mfg. Co.,

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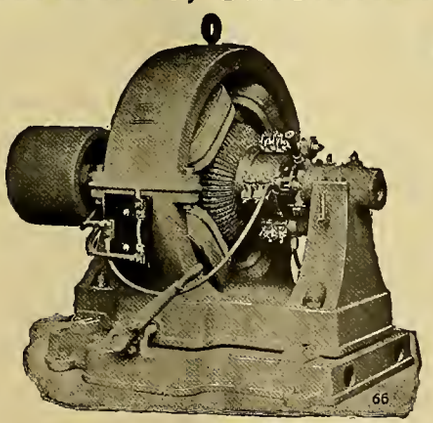
ELECTRIC LIGHT AND POWER PLANTS, AND SLOW SPEED MOTORS.



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"AMERICAN" STORAGE CELLS
ARE THE BEST. Send for Descriptive Circular.
Absolutely Non-Infringing.
Protection Guarantee.
AMERICAN BATTERY CO.,
ESTD 1890. 38 W. Quincy St., Chicago, Ill.

EVERYTHING IN WIRE.

BARE AND INSULATED.

ALSO MANUFACTURERS OF THE "CHICAGO" RAIL BOND.

WASHBURN & MOEN MFG. CO.,

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BRANCH OFFICES AND WAREHOUSES: New York, Chicago, San Francisco, Houston, Philadelphia, Pittsburg, Boston.

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COMPLETE STOCK CARRIED BY

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

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Electric Appliance Co., Chicago.
Pettingell Andrews Co., Boston.
Electrical Engineering Co., Minneapolis.
St. Louis Electrical Supply Co., St. Louis.
The Bradford Belting Co., Cincinnati

Phillips Insulated Wire Co.,

Office and Factory: PAWTUCKET, R. I.

WANTED.

A second-hand Corliss engine, 400 or 450 horse power, right hand and 24x48. Must be in good condition. Address R. H. WOMACK, City Clerk, Hannibal, Mo.

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Long Distance Tel. 744 Express.
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NOTICE TO BIDDERS.

Notice is hereby given that bids will be received by the Common Council of the City of Niagara Falls up to and including the first day of November, 1897, at 8 o'clock p. m., for the exclusive furnishing of electric arc lights to the City of Niagara Falls for a period of five years from November 1, 1898, according to specifications on file with the city clerk.

Each bid shall give the name and address of the bidder and shall state the price per annum for which the bidder will furnish each electric arc light of a two thousand (2,000) candle lamp power for said term.

The estimated number of arc lights to be furnished is three hundred (300) with the right of the Common Council of the said city to increase or decrease the said number as it may elect during said term.

The successful bidder will be required to enter into contract for the furnishing of such number of electric arc lights as may be required for such term at the price per annum named in its bid and to furnish bond in twenty thousand dollars ($20,000) for the faithful performance of said contract.

Each bidder must accompany his bid with a certified check for ten thousand dollars ($10,000) as a guarantee that he will enter into contract if the same is awarded to him.

Further information, if desired, will be furnished by the city clerk upon application.

All bids shall be opened at the meeting of the Common Council to be held Monday, November 1, 1897.

The Common Council reserves the right to reject any or all bids.

Dated August 16, 1897.

By order of the Common Council.

S. F. ARKUSH,
City Clerk.

PROPOSALS FOR LIGHTING.

OFFICE OF THE CITY CLERK.

Proposals for lighting the streets of the city of Lorain, Ohio.

Sealed proposals will be received at the office of the City Clerk in the Wagner building until Sept. 6, 1897, at 12 o'clock noon, for the lighting, furnishing, extinguishing and keeping in repair, including the furnishing of glass and all materials necessary therefor, for 50 electric lamps more or less, of 1,200 or 2,000 candle power each. Also for the lighting, furnishing and extinguishing and keeping in repair of such number of gas or vapor lamps as will be equivalent to 50 electric lamps of 2,000 candle power each, and the furnishing of poles and other equipments therefor for a period of five years and ten years alternating bids.

Specifications can be seen at the office of the City Clerk.

Each proposal must contain the full name of the party or parties making the same, and all persons interested therein, and must be accompanied by a five-hundred-dollar certified check on a solvent bank in the city as surety that if the proposals be accepted a contract will be entered into.

No proposals will be entertained unless delivered at the office of the city clerk in the Wagner building by 12 o'clock noon, Sept. 6, 1897.

The city reserves the right to reject any and all bids.

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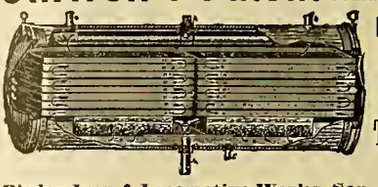

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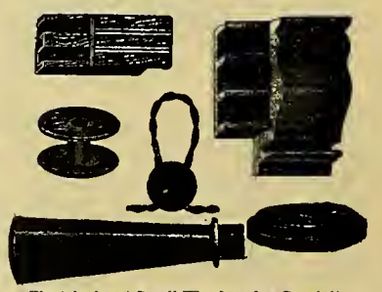

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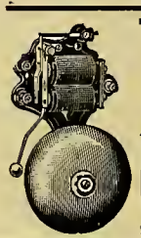

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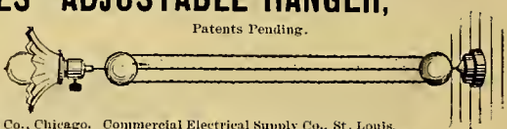

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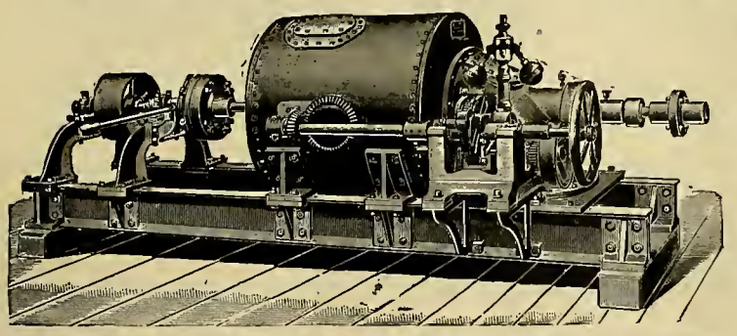

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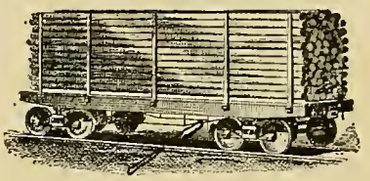

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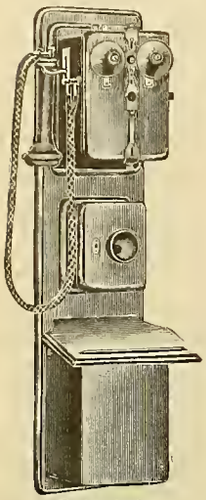

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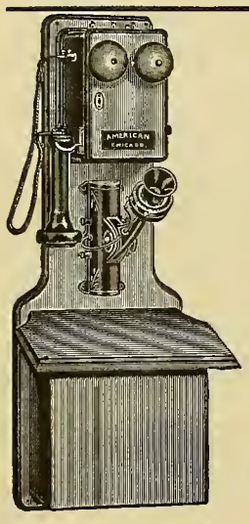

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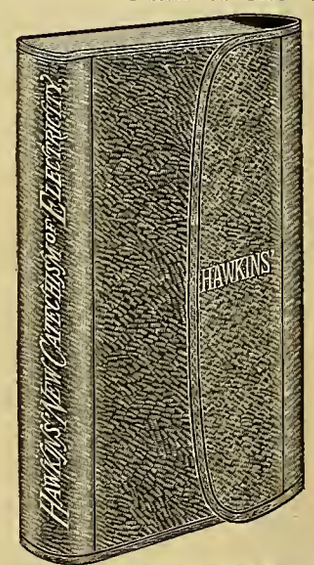

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The Dynamo; Conductors and Non-Conductors; Symbols, abbreviations and definitions relating to electricity; Parts of the Dynamo; The Motor; The Care and Management of the Dynamo and Motor.
Electric Lighting; Wiring; The rules and requirements of the National Board of Underwriters in full; Electrical Measurements.
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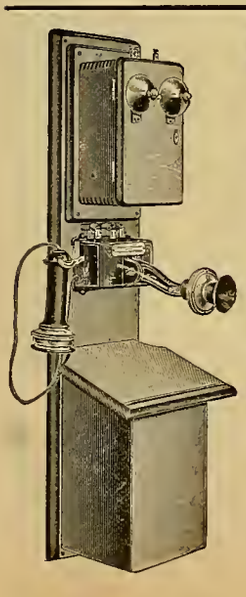

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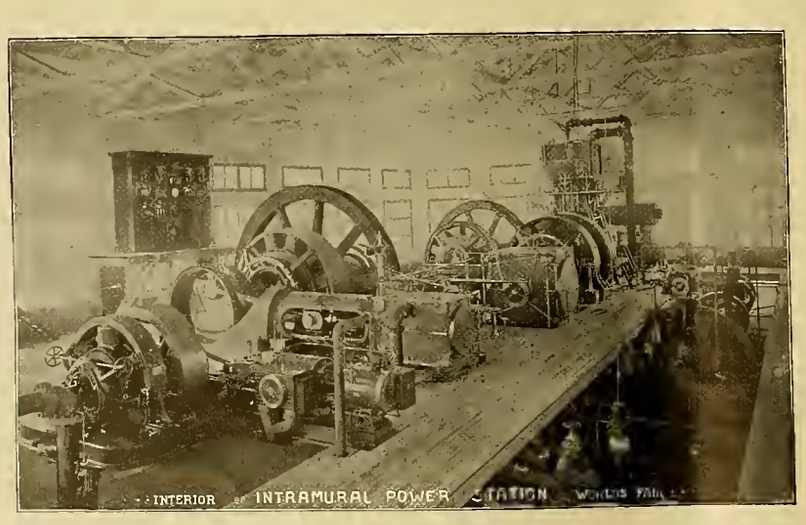

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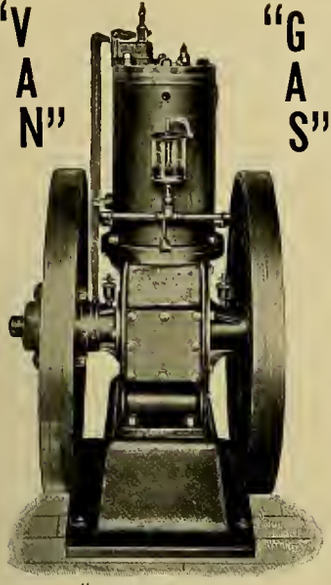

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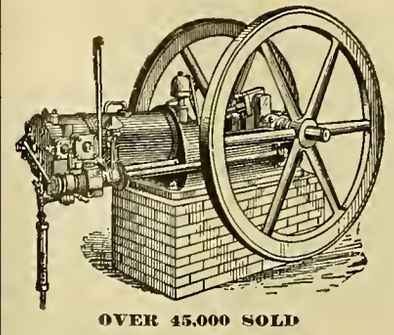

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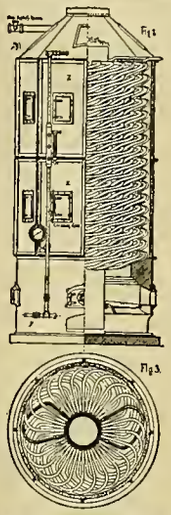

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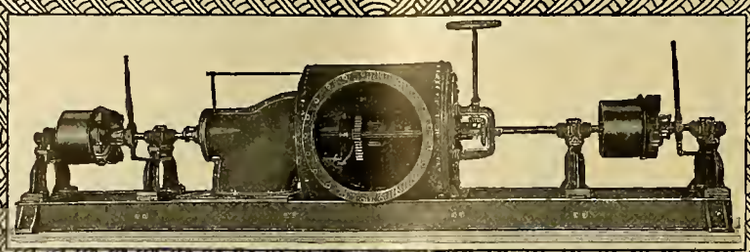

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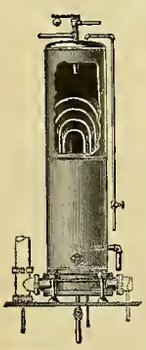

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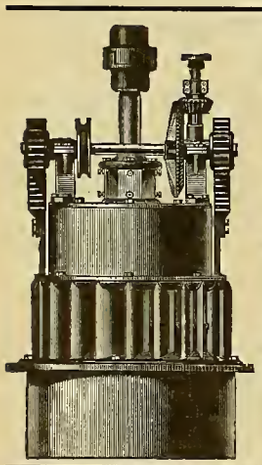

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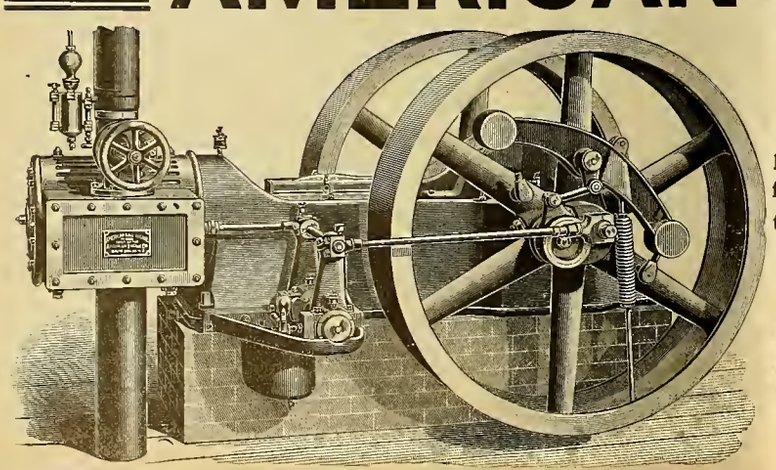

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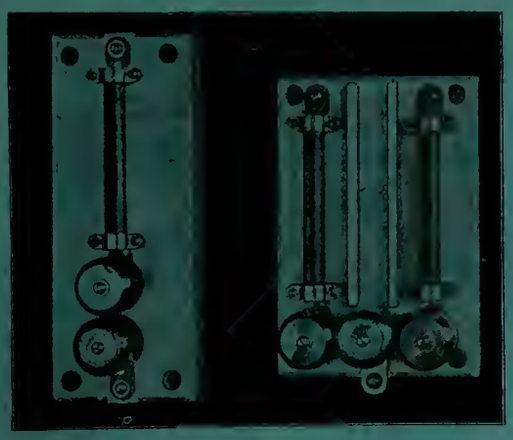

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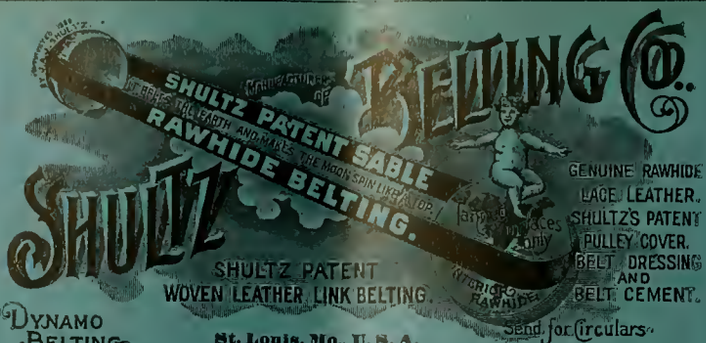

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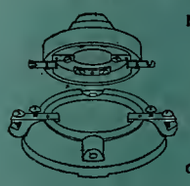
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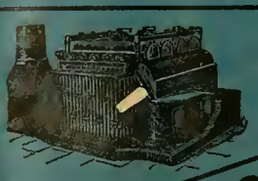

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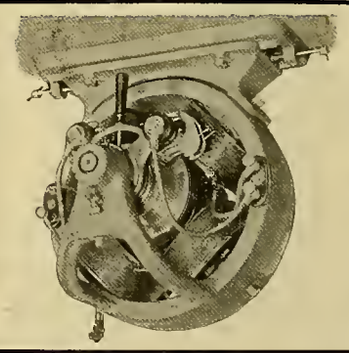

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Zamel Arc Lt. Meter Co. xxii

For Classified Index of Advertisements See Page VI.

PARAGON

FAN MOTORS.

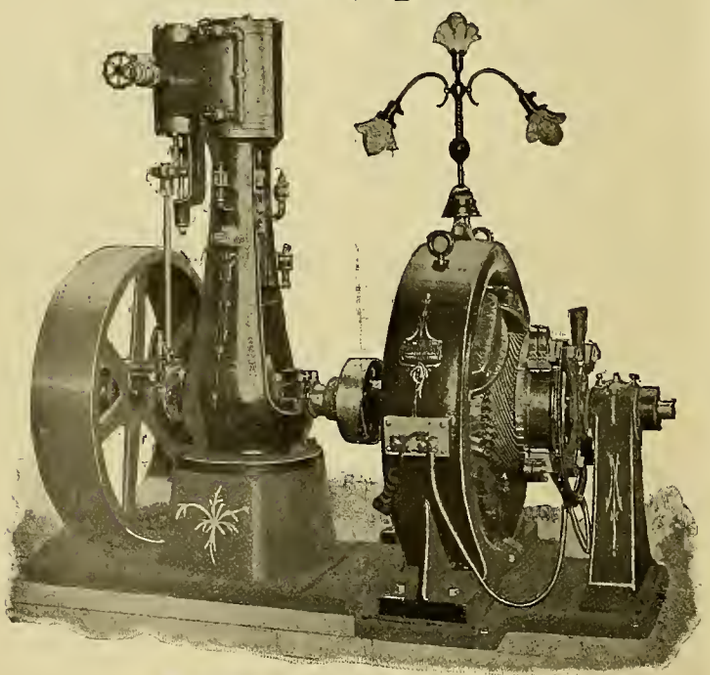
CHICAGO EDISON COMPANY,

139 ADAMS STREET, CHICAGO.

YOUR TIME HAS COME

TO ECONOMIZE.

Independent Lighting Plants of Medium Size, or Plants of any Size for Manufactories, Hotels and Large Stores.



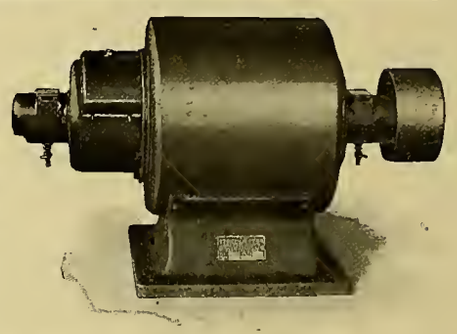
Send for New Catalogue.

TRIUMPH ELECTRIC CO.,

CINCINNATI, OHIO.

THE . . .

Storey Motors.



Iron-clad. Completely Closed In. Dust and Moisture Proof. No External Magnetism.

Specially Adapted for Direct Connection to Machinery.

Special Direct Current Motors for All Classes of Work.

THE STOREY MOTOR & TOOL CO.,

MAIN OFFICE AND FACTORY: 212-226 Carter St., Philadelphia, Pa.

BRANCH FACTORY: Hamilton, Canada.

THE ORIGINAL PATENTEES AND MANUFACTURERS OF

Cement-Lined Ducts

Engineers and Contractors for Complete Subways.

Address all Correspondence: NEW HAVEN, CONN.

The Connecticut Pipe Manufacturing Company,

Office and Factory, West Haven, Conn.

Business Established 1865.
Incorporated 1892.

E. H. PHIPPS, President.
GEO. O. RICHARDS, Secretary
CHARLES WARD, Gen. Mgr.

The Tuerk Alternating Current Ceiling Fan.

1897 PATTERNS NOW READY.

Some New Features Embodied in Our '97 Product Make It Better than Ever.

MADE FOR FROM 50 TO 120 VOLTS.
50, 125 AND 140 CYCLES.

SPECIAL FEATURES:
High Economy.
Self-Oiling Bearings.
Adjustable Blades.
Starting Switch at Bottom.

Five different styles of finish—Bronze, Bower-Barff, Ivory and Gold, Nickel, Polished Brass.

THE HANDSOMEST FAN ON THE MARKET.

Strong, Reliable, Noiseless, Durable, Ornamental and Inexpensive to Operate.

SEND FOR 1897 CATALOGUE.

HUNTER FAN & MOTOR CO.,

FULTON, NEW YORK.

E. B. LATHAM & CO., General Selling Agents, 136 Liberty Street, New York, U. S. A.

OKONITE OKONITE

IF prosperity or increased business or better times is to be the actual result of all this talk, if there is a prospect of a realization after years of anticipation, it would seem to be a sensible proposition for everyone to fall in line and help push. If there are good things to be distributed we all want our share, but good things are not coming to anyone unless he gets out and hustles to secure them.

Years of decreased profits and increased competition have prevented many needful repairs and extensions, but it is "in the air" that the coming Fall and Winter will see an enormous impetus given the various electrical industries, and it behooves everyone to get ready for it.

We have that faith in present conditions that we are "stocking up" much heavier than ever before in anticipation of your Fall business; shall we be so favored?

Central Electric Company,

1887–1897.

Geo. A. McKinlock, President.
Charles E. Brown, Secretary.
S. R. Frazier, Treasurer.

173-175 Adams Street, Chicago.

OKONITE OKONITE

SUPPLIES SUPPLIES

NEAR HOME - FULL STOCK

PEOPLES ELECTRIC Co., MADISON, WIS

Now, boys, you've had a good rest—
get ready for next month—
new tune—same old words:—

"Low prices—big stock—
"Quick shipment to you.
"Some quote 'bed-rock' (?)
"**We always do!**"

CLASSIFIED INDEX OF ADVERTISEMENTS.

Accumulators.
American Battery Co.
Central Electric Co.
Electric Storage Battery Co.
Ohio Storage Battery Co.
Willard El. & Battery Co.

Annunciators.
Central Electric Co.
Commercial El. Supply Co.
Edwards & Co.
Electric Appliance Co.
Partrick & Carter Co.

Arc Lamps.
Central Electric Co.
Commercial El. Supply Co.
Diehl Mfg Co.
Electric Arc Light Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Manhattan Gen'l Cons. Co.
Peoples Electric Co.
Puritan Electric Co.
Westinghouse El. & Mfg. Co.

Arc Light Cord.
Central Electric Co.
Samson Cordage Wks.

Batteries and Jars.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
Elec. Gas Lighting Co.
Gordon-Burnham Battery Co
Leclanche Battery Co., The.
Muir & Son, Thos.
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Peru Elec. Mfg. Co.

Bells.
Central Electric Co.
Commercial El. Supply Co.
Edwards & Co.
Electric Appliance Co.
Huebel & Manger.
Ohio Electric Works.
Partrick & Carter Co.

Belting.
Jewell Belting Co.
Main Belting Co.
Peerless Rubber Mfg. Co.
Shultz Belting Co.

Boilers.
Clonbrook Steam Boiler Co.

Books, Electrical.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Commercial El. Supply Co.
Holmes Fibre-Graphite Co.
Partridge Carbon Co.

Burglar Alarms.
Central Electric Co.
Commercial El. Supply Co.
Edwards & Co.
Electric Appliance Co.
Huebel & Manger.
Partrick & Carter Co.

Cables (See Insulated Wires.)
Cables, Electric (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Eastern Electric Cable Co.
General Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C Co.
Washburn & Moen Mfg. Co.

Carbons, Points & Plates.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co
Gen'l Inc. Arc Light Co.
Partridge Carbon Co.
Reisinger, Hugo.

Cars.
Brill Co., J. G.

Compound.
Central Electric Co.
California Asphalt Co.
Commercial El. Supply Co.
Electric Appliance Co.
Johns Mfg. Co., H. W.
McLennan & Co., K.
Okonite Co.

Conduits.
Armorite Interior Cond. Co.
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Conn. Pipe Mfg. Co.
Electric Appliance Co.
Muir & Son, Thos.

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Hodge, Walsh & Loring.
Keystone Electric Co.
McFell Electric Co.
McRae, A. L.
Thordarson, C. H.
United Elec. Imp. Co.
Wagner Elec. Mfg. Co.
Warren Electric Mfg. Co.

Contractors and Electric Light Plants.
Ahlm-Edwards El. Co.
Arnold El. Pr. Station Co.
Bain, Foree.
Bullock Elec. Mfg. Co.
Card Electric Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hodge, Walsh & Loring.
Keystone Electric Co.
McRae, A. L.
Northern Electl. Mfg. Co.
Peoples Electric Co.
Scott & Janney El. & Mfg. Co.
Siemens & Halske Elec. Co.
Triumph Electric Co.
United Elec. Imp. Co.
Wagner Elec. Mfg. Co.
Warren Electric Mfg. Co.
Westinghouse Elec & Mfg Co.

Copper.
Besly & Co., Chas. H.
Central Electric Co.
Mansfield Temp. Copper Co.
Mitchell Temp. Copper Co.

Copper Wires.
American Electrical Works.
Besly & Co., Chas H.
Brixey, W. R.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
General Electric Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

Cordage.
Central Electric Co.
Samson Cordage Wks.

Correspondence Schools.
Int. Correspond. Schools.

Crookes' Tubes.
Central Electric Co.
Commercial El. Supply Co.

Cross-Arms, Pins and Brackets.
Brady, T. H.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Point Marion Mfg. Co.

Cut-Outs and Switches.
Automatic Clr. Breaker Co.
Bryant Electric Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Cutter El. & Mfg. Co.
Eddy Elec. Mfg. Co.
Electric Appliance Co.
Emerson El. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Elec. Co.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Palste Co., H. T.
Peoples Electric Co.
Peru Elec Mfg. Co.
Wagner Elec. Mfg. Co.
Westinghouse El. & Mfg.Co.

Dynamos.
Ahlm-Edwards El. Co.
American Engine Co.
Bullock Elec Mfg. Co.
Card Electric Co.
Central Electric Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Keystone Electric Co.
Muir & Son, Thos.
Northern Electl. Mfg. Co.
Scott & Janney El. & Mfg.Co.
Siemens & Halske Elec. Co.
Triumph Electric Co.
United Elec. Imp. Co.
Wagner Elec. Mfg. Co.
Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Fuel Economizer Co.

Electric Heat'g App's.
American El. Heating Corp.
Central Electric Co.
Globe Electric Heating Co.
Johns, H. W., Mfg. Co.

Electric Meters.
American El. Meter Co.
Central Electric Co.
Zamel Arc Light Meter Co.

Electric Railways.
General Electric Co.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Bain, Foree.
McRae, A. L.
Pratt, Chas. A.

Electrical Instruments.
Automatic Clr. Breaker Co.
Central Electric Co.
Commercial El. Supply Co.
Cutter El. & Mfg. Co.
Electric Appliance Co.
Emerson El. Mfg. Co.
General Electric Co.
Hill, W. S. Electric Co.
Keystone El. Instrument Co.
Palste Co., H. T.
Queen & Co.
Wagner Elec. Mfg. Co.
Weston Electrical Inst. Co.

Electrical Specialties.
Automatic Clr. Breaker Co.
Central Electric Co.
Commercial El. Supply Co.
Hill, W. S. Electric Co.
Palste Co., H. T.
Peru Elec. Mfg. Co.
Splitdorf, C. F.
Thordarson, C. H.
Vought, M. I.

Electrical Woodwork.
Lever, C. H. Mfg. Co.

Electro-Plating Mach'y.
Healy & Co., Chas. H.
General Electric Co.

Engines, Gas.
Otto Gas Engine Wks.
Prouty Co., The.
Van Horne, Burger & Co.

Engines, Steam.
American Engine Co.
Ball Engine Co.

Fan Outfits.
Central Electric Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
Emerson El. Mfg. Co.
General Electric Co.
Hunter Fan & Motor Co.
Scott & Janney El. & Mfg. Co.
Wagner Electric Mfg. Co.
Western Elec. Co.
Westinghouse El. & Mfg. Co.

Feed Water Heaters.
Davis & Son, I. B.

Fibre.
Delaware Hard Fibra Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.
Central Electric Co.

Fixtures, El. & Comb'n.
Central Electric Co.
Commercial El. Supply Co.

Fuses.
D. & W. Fuse Co.

Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
Commercial El. Supply Co.
Electric Appliance Co.

Gaskets.
Johns, H. W., Mfg. Co.
Peerless Rubber Mfg. Co.

Gas Lighting, Electric.
Central Electric Co.

Gears.
Healy & Co., Chas. H.
Central Electric Co.

General Elec. Supplies.
Besly & Co., Chas. H.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
General Electric Co.
Hill, W. S. Electric Co.
Hodge, Walsh & Loring.
Ohio Electric Works.
Palste Co., H. T.
Partrick & Carter Co.
Peoples Electric Co.
Peru Elec. Mfg. Co.

Globes and Electrical Glassware.
Central Electric Co.
Commercial El. Supply Co.

Gov'nors, Water Wheel.
Lombard Water Wheel Gv. Co.

Graphite Specialties.
Healy & Co., Chas. H.
Central Electric Co.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Induction Coils.
Central Electric Co.
Queen & Co.
Splitdorf, C. F.

Insulators and Insulating Materials.
Brixey, W. R.
Bryant Electric Co.
California Asphalt Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
Emerson El. Mfg. Co.
Empire China Works.
Hill, W. S. Electric Co.
Hodge, Walsh & Loring.
Johns Mfg. Co., H. W.
Mica Inaulator Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Palste Co., H. T.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Wagner Elec. Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

Lamp Adjusters.
Vought, M. I.

Lamps, Incandescent.
Buckeye Electric Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
General Electric Co.,
Lynn Incandescent Lp. Co.
Ohio Electric Works.
Sawyer-Man Elec. Co.
United Elec. Imp. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Lamp Trim'r's Wagons.
Studebaker Bros. Mfg. Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Westinghouse El. & Mfg. Co.

Magnet Wire.
(See Insulated Wires.)

Mechanical Machinery.
Besly & Co., Chas. H.
Garvin Machine Co., The.
Stilwell-Bierce Smith-Valle.

Mica.
Central Electric Co.
Commercial El. Supply Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
General Electric Co.
Westinghouse El. & Mfg. Co.

Motors.
Ahlm-Edwards Elec. Co.
American Engine Co.
Belknap Motor Co.
Bullock Elec. Mfg. Co.
Card Electric Co.
Central Electric Co.
Commercial El. Supply Co.
Crocker-Wheeler Elec. Co.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Keystone Electric Co.
Muir & Son, Thos.
Northern Electl. Mfg. Co.
Ohio Electric Works.
Peoples Electric Co.
Scott & Janney El. & Mfg. Co.
Stanley Elec. Mfg. Co.
Storey Motor & Tool Co.
Triumph Electric Co.
United Elec. Imp. Co.
Wagner Elec. Mfg. Co.
Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co

Packing.
Healy & Co. Chas. H.
Garlock Packing Co.
Johns, H. W., Mfg. Co.
Peerless Rubber Mfg. Co.

Paints.
California Aaphalt Co.
Central Electric Co.
Commercial El. Supply Co.
Johns, H. W. Mfg. Co.

Phosphor Bronze.
Healy & Co., Chas. H.
Phoaphor Bronze Sm. Co. Ltd.

Platinum.
Baker & Co.

Poles.
Lindsley Bros.
McLean, A. J.
National Tube Works Co.
Northern Supply Co.
Perrizo & Sons.
Point Marion Mfg. Co.
Sterling & Son, W. C.

Porcelain.
Bryant Electric Co.
Central Electric Co.
Commercial El. Supply Co.
Empire China Works.
Peru Elec. Mfg. Co.

Push Buttons.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Emerson El. Mfg. Co.
Partrick & Carter Co.

Refiners.
Swarts Metal Refining Co.

Reflectors.
Muir & Son, Thos.

Regulators.
Belknap Motor Co.

Re-Winding—Repairs.
Central Electric Co.
Chicago Edison Co.
Electrical Exchange, The.
Elliott, W. H. Elec. Co.
Hodge, Walsh & Loring.
Thordarson, C. H.

Rheostats.
Am. El. Heat. Corporation.
Central Electric Co.
General Electric Co.
Iron Clad Rheostat Co.
Leonard, Ward, Elec. Co.
Muir & Son, Thos.
Westinghouse El. & Mfg. Co

Second-Hand Machin'y.
Cornman Co.
Electrical Exchange, The.
Elliott, W. H. Elec. Co.

Shades.
Central Electric Co.
Muir & Son, Thos.

Speaking Tubes.
Central Electric Co.
Electric Appliance Co.
Partrick & Carter Co.

Speed Indicators.
Besly & Co., Chas. H.
Central Electric Co.
Keystone El. Instrument Co.
Queen & Co.
Weston Electrical Inst. Co.

Steel Pipe.
National Tube Works Co.

Storage Batteries.
American Battery Co.
Central Electric Co.
Electric Storage Battery Co.
Ohio Storage Battery Co.
Willard El. & Battery Co.

Tapes, Insulating.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Moore, Alfred F.
New York Insulated Wire Co
Okonite Co., The.
Simplex Electrical Co.
Washburn & Moen Mfg. Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Climax Novelty Co.
Commercial El. Supply Co.
Kusel, D A., Tel. Mfg. Co.
Lockwood T. & T. Co. of Am
McFell Electric Co.
Mo. Tel. Mfg. Co.
Orne Elec. Cons. Co.
Peoples Electric Co.
Splitdorf, C. F.
Standard Tel. & El. Co.
Stromberg-Carlson Tl. M. Co.
Taber & Mayer.
Viaduct Mfg. Co.
Western Tel. Cons. Co.

Transformers.
Central Electric Co.
Commercial El. Supply Co.
Diamond Elec. Co.
Ft. Wayne Elec. Corporation
General Electric Co.
Stanley Electric Mfg. Co.
Wagner Elec. Mfg. Co.
Westinghouse El. & Mfg. Co.

Trolley Cord.
Central Electric Co.
Samson Cordage Wks.

Trucks, Electric Car.
Brill Co., J. G.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle.

Water Wheels.
Am. Impulse Wheel Co.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle

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Washburn & Moen Mfg. Co.

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Commercial El. Supply Co.
Queen & Co.
Splitdorf, C. F.

For Alphabetical Index of Advertisements See Page III.

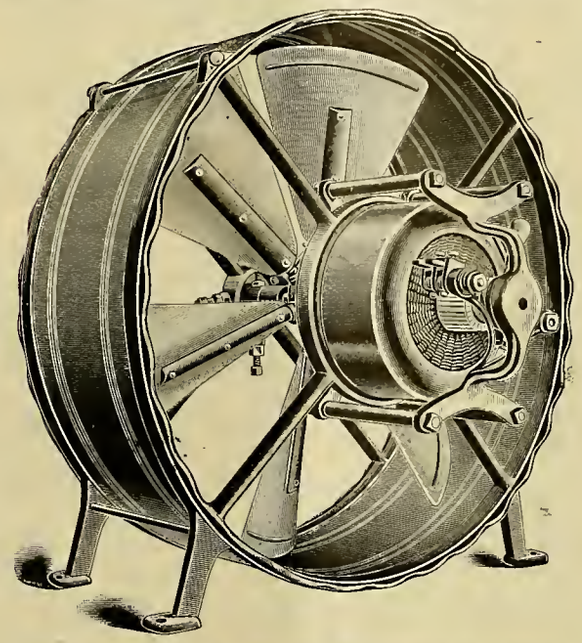
DIEHL ELECTRIC FANS.

Ceiling Fans and Exhaust Wheels

Wound for Any Current, Except Alternating.

Our Exhaust Wheel Combinations

Are the most compact and efficient made.
Write for catalogue and prices.



Propeller or Desk Fans

Wound for 110, 220 or in series on 500 volts.
Also for Primary or Secondary Battery Circuits.

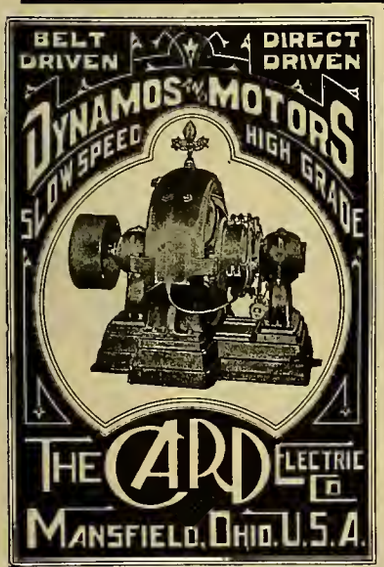
Highest Efficiency

Unbroken Magnetic Circuit, Self-Aligning Bronze Bearings. Finest Insulation Throughout. Four-Speed Regulator.

SHOW ROOMS: New York, 561-563 Broadway; Chicago, 192-194 Van Buren St.; Boston, 128-132 Essex St.

DIEHL MANUFACTURING CO., ELIZABETHPORT, NEW JERSEY.

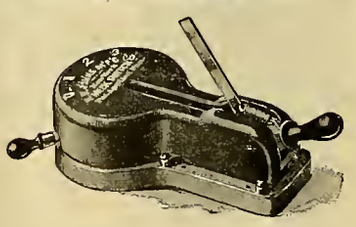
Agents for Canada: Canadian General Electric Co., Toronto, Ontario.



"H. W. J." Electric Car Heaters.

SIMPLE, DURABLE, EFFECTIVE, ECONOMICAL.

Heat evenly distributed full length of car. Three degrees of regulation with patented knife switch. No coils to short-circuit or break.



Trolley Line Insulators,
Vulcabeston Controller Parts,
Commutator Rings, Bushings, Etc.

H. W. Johns Manufacturing Co.,
240-242 RANDOLPH ST., CHICAGO, ILL.
New York. Philadelphia. Boston. London.

FUSE WIRE AND LINKS FOR ALL SYSTEMS. Correct Carrying Capacity. Absolutely Uniform.

CHICAGO FUSE WIRE & MFG. CO.,
153 Lake St., Chicago.

Westinghouse Polyphase Apparatus Supreme.

Generators, Motors, Transformers, for Two-Phase, Three-Phase and C. F. Scott Two-Phase Three-Phase System of Alternating Current Power Transmission.

26,000 H. P. IN OIL-INSULATED TRANSFORMERS CONSTRUCTED.

Potentials from 5,000 to 50,000 Volts. All Apparatus Necessary for 100 Mile Transmission.

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., PITTSBURG, PA.

New York, 120 Broadway.
Boston, Exchange Bldg.
Buffalo, N. Y., 8 Erie Co. Bank Bldg.
Charlotte, N. C., 36-38 College St.
Chicago, N. Y. Life Bldg.
Philadelphia, Girard Bldg.
Pittsburg, Westinghouse Bldg.
St. Louis, American Central Bldg.
San Francisco, Mills Bldg.
Syracuse, N. Y., Bastable Bldg.
Tacoma, Wash., 102 S. 10th St.
Atlanta, Ga., Equitable Bldg.
Westinghouse Electric Co., Ltd., 32 Victoria St., London, S. W., England.
For Canada address Ahearn & Soper, Ottawa, Ont.

THE S. K. C. SYSTEM.

A COMPLETE SYSTEM FOR

Long Distance Transmission, General Station Distribution, Mill and Factory Equipment.

Generators will be wound and guaranteed for an E. M. F. as high as

10,000 VOLTS.

CORRESPONDENCE SOLICITED

STANLEY ELECTRIC MANUFACTURING COMPANY,

Pittsfield, Mass., U. S. A.

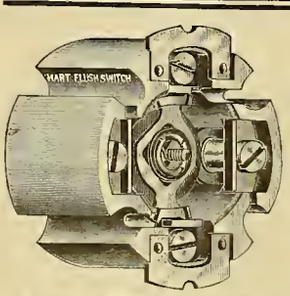
THE ROYAL ELECTRIC CO., Montreal, Canada, are sole licensees for the manufacture and sale of the S. K. C. System in Canada. . . . . .

BRANCHES OFFICES:
Chicago, 1506 Marquette Building.
Boston, Equitable Building.
New York, 39 Cortlandt St.
San Francisco, 800 California St.
Anderson, S. C.

NEW HART FLUSH SWITCHES

IN GANGS OF ANY NUMBER.

THE SWITCHES ARE INSERTED AND CONNECTED UP FROM THE FRONT.

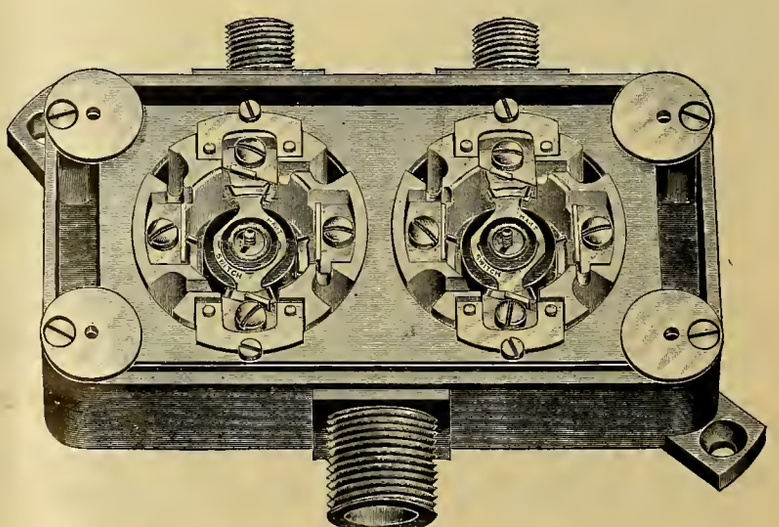


FLUSH SWITCH FOR GANGS.

The Cut shows a No. 2 Box for iron armored conduit, with a gang of two switches.

The boxes are furnished with any number of outlets desired.

Switches are "Indicating."



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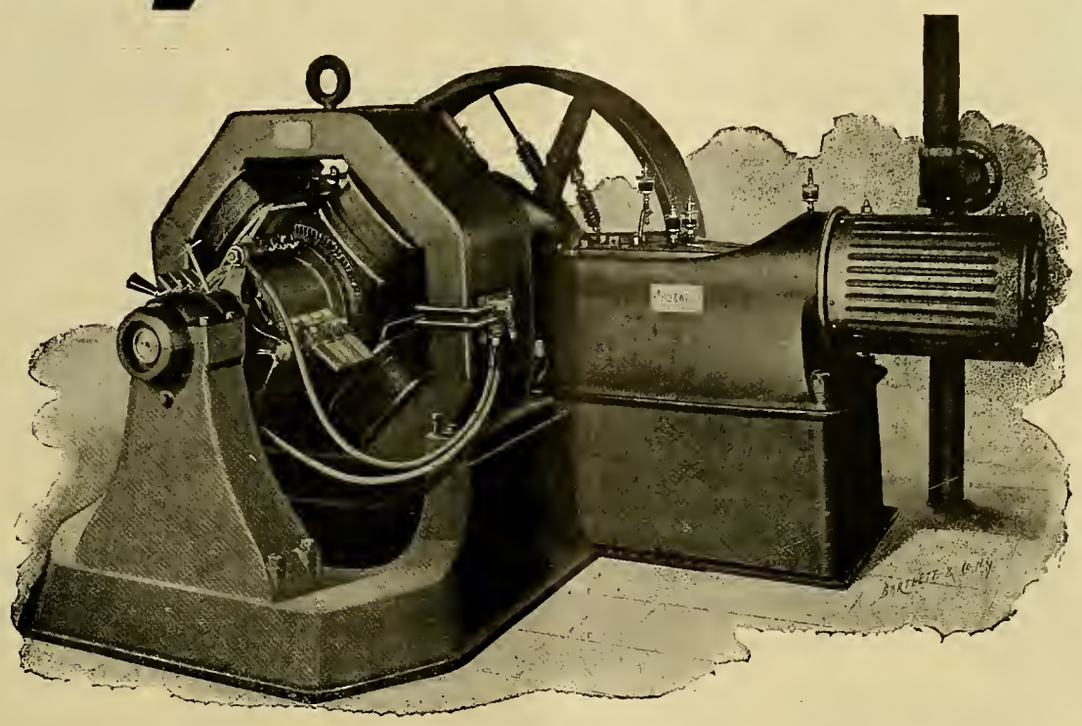

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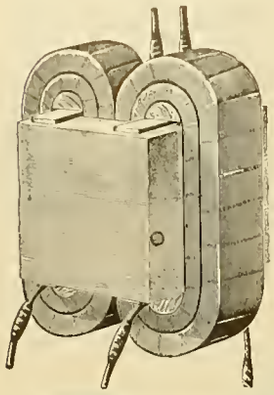

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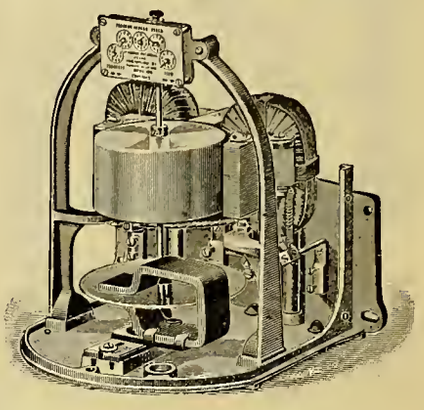

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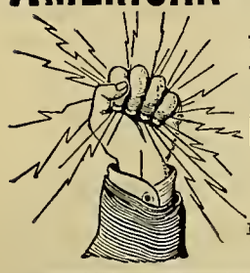

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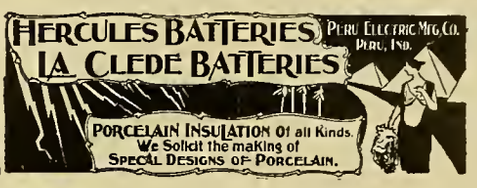

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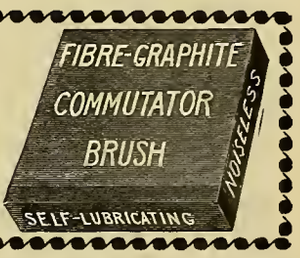

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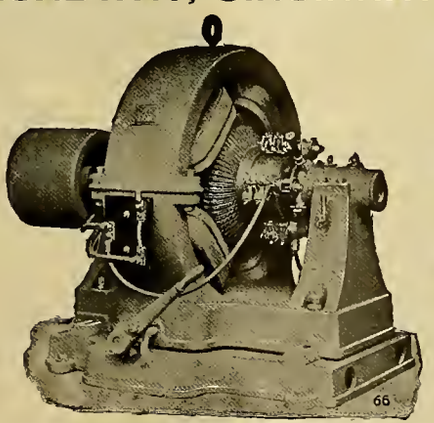

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The city of Asheville, N. C., desires bids for furnishing and maintaining one hundred to one hundred and fifty electric arc lights of two-thousand (2,000) candle power each.

The city reserves the right to reject any or all bids. Bids to be received until Sept. 20, 1897.

GEO. F. SCOTT, Chairman,
Special Light Committee,
Asheville, N. C.

NOTICE TO BIDDERS.

Notice is hereby given that bids will be received by the Common Council of the City of Niagara Falls up to and including the first day of November, 1897, at 8 o'clock p. m., for the exclusive furnishing of electric arc lights to the City of Niagara Falls for a period of five years from November 1, 1898, according to specifications on file with the city clerk.

Each bid shall give the name and address of the bidder and shall state the price per annum for which the bidder will furnish each electric arc light of a two thousand (2,000) candle lamp power for said term.

The estimated number of arc lights to be furnished is three hundred (300) with the right of the Common Council of the said city to increase or decrease the said number as it may elect during said term.

The successful bidder will be required to enter into contract for the furnishing of such number of electric arc lights as may be required for such term at the price per annum named in its bid and to furnish bond in twenty thousand dollars ($20,000) for the faithful performance of said contract.

Each bidder must accompany his bid with a certified check for ten thousand dollars ($10,000) as a guarantee that he will enter into contract if the same is awarded to him.

Further information, if desired, will be furnished by the city clerk upon application.

All bids shall be opened at the meeting of the Common Council to be held Monday, November 1, 1897.

The Common Council reserves the right to reject any or all bids.

Dated August 16, 1897.

By order of the Common Council.

S. F. ARKUSH,
City Clerk.

PROPOSALS FOR LIGHTING.

OFFICE OF THE CITY CLERK.

Proposals for lighting the streets of the city of Lorain, Ohio.

Sealed proposals will be received at the office of the City Clerk in the Wagner building until Sept. 6, 1897, at 12 o'clock noon, for the lighting, furnishing, extinguishing and keeping in repair, including the furnishing of glass and all materials necessary therefor, for 50 electric lamps more or less, of 1,200 or 2,000 candle power each. Also for the lighting, furnishing and extinguishing and keeping in repair of such number of gas or vapor lamps as will be equivalent to 50 electric lamps of 2,000 candle power each, and the furnishing of poles and other equipments therefor for a period of five years and ten years alternating bids.

Specifications can be seen at the office of the City Clerk.

Each proposal must contain the full name of the party or parties making the same, and all persons interested therein, and must be accompanied by a five-hundred-dollar certified check on a solvent bank in the city as surety that if the proposals be accepted a contract will be entered into.

No proposals will be entertained unless delivered at the office of the city clerk in the Wagner building by 12 o'clock noon, Sept. 6, 1897.

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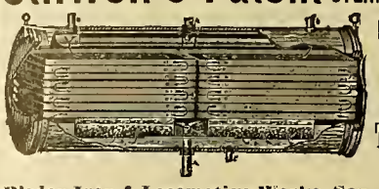

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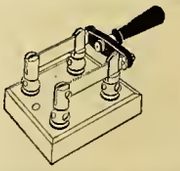

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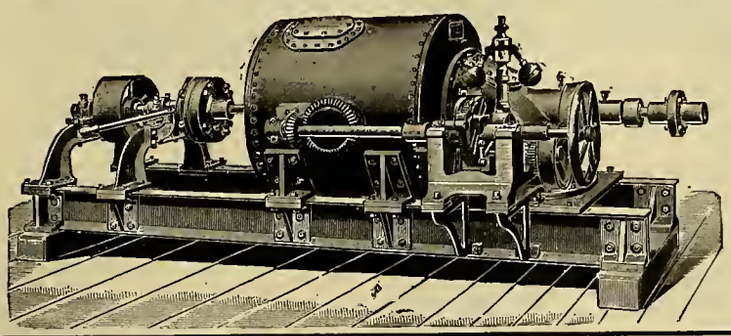

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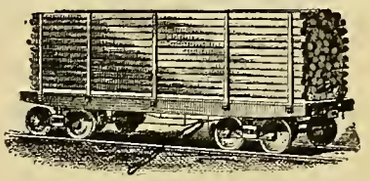

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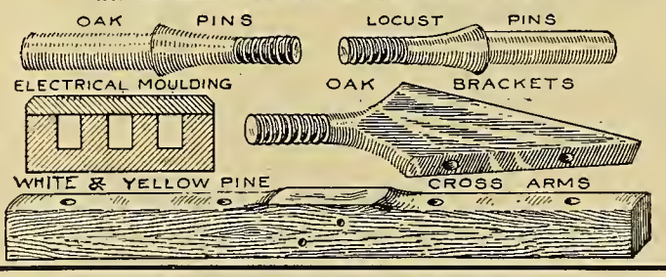

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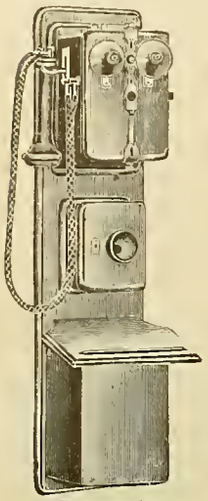

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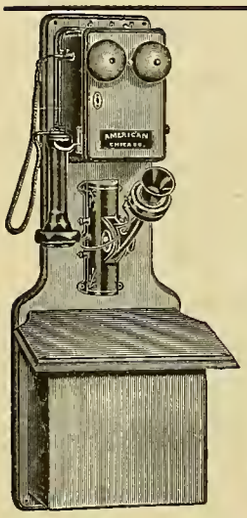

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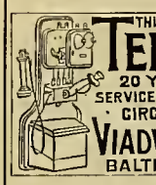

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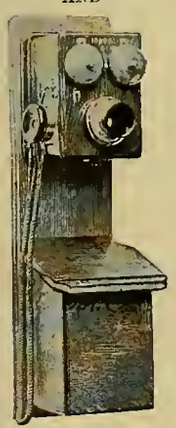

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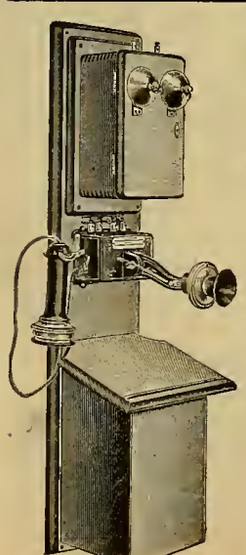

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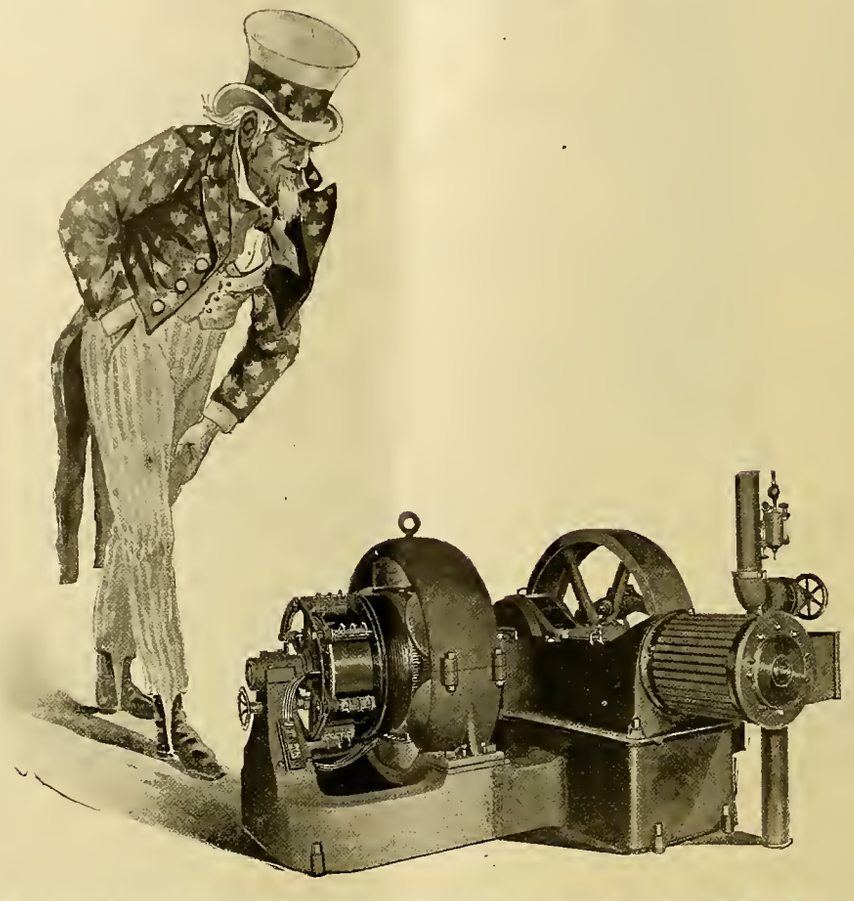

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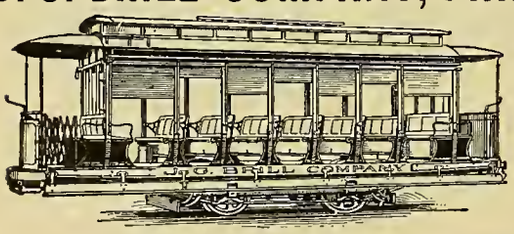

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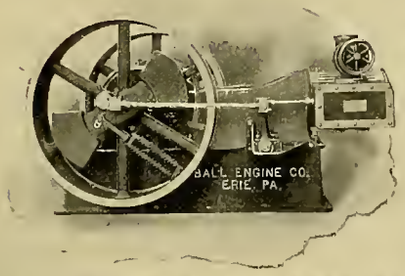

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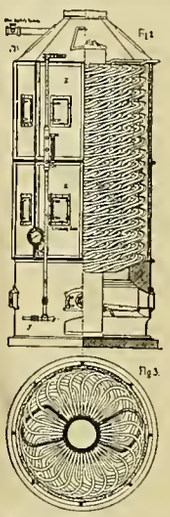

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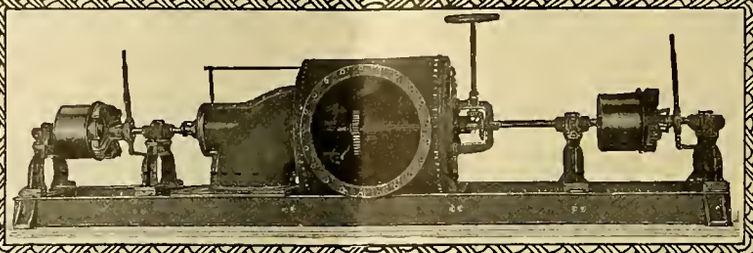

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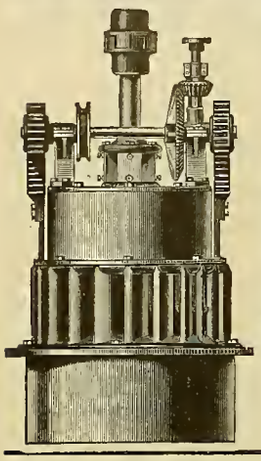

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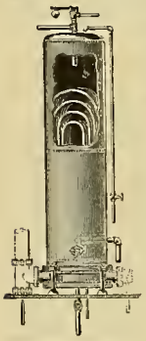

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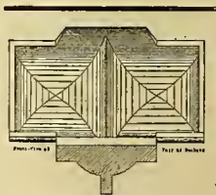

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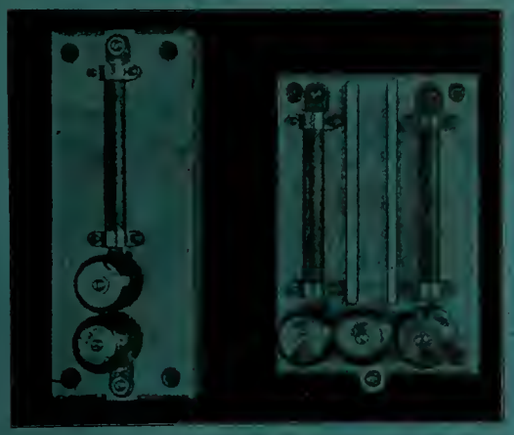

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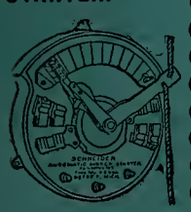

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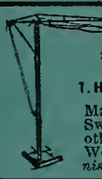

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WE CLAIM:—Constant discharge of current without polarization; no local action; no noxious gases or fumes; no acids; least labor for operation; cleanest; not freezing at 28° below zero; economic value 50 per cent. greater than gravity cell, and 30 per cent. greater than best other cell in market. For No. 1 cell, 250 ampere hours; for No. 2 cell, 100 ampere hours; on open circuit, .9 to 1 volt; on closed circuit, .65 to $\frac{7}{8}$ volt. Send for circular and price list.

THE GORDON-BURNHAM BATTERY CO.,

82 to 86 West Broadway, New York City.

General Western Agent, S. F. B. MORSE, Marquette Bldg., Chicago, Ill.

REPAIRS.

If the Chicago Telephone Co., the Postal Telegraph Co., the Western Union Telegraph Co. and the Central Union Telephone Co. are satisfied with the work we have done for them, do you not think we can do YOUR work to YOUR entire satisfaction?

We make a specialty of Winding Armatures of any size or system, Transformers, Field Magnet Coils, Repairing Telephone and Telegraph Apparatus, Electrical Instruments and Machinery.

ELECTRICAL MANUFACTURING OF ANY KIND.

We have done work for the following well known companies for years, to whom we refer you (with their permission) for references:

CHICAGO TELEPHONE CO., J. C. Kenny, Purchasing Agent.
POSTAL TELEGRAPH-CABLE CO., J. F. Butterfield, Asst. Elec. Eng., Chicago.
CENTRAL UNION TELEPHONE CO., S. G. McMeen, Chief Elec. Eng.
WESTERN UNION TELEGRAPH CO., Chicago, Eng. Dept.

Let us figure with you before placing your repair work.

C. H. THORDARSON, Electric Block, 82 Market St., Chicago.

EDDY GENERATORS.

Direct Connected or Belted for Electric Railways, Central Stations, Isolated Lighting or Power Plants.

Eddy Motors—Slow, Medium or High Speed.

We build all necessary apparatus for the transmission of Electrical Power through factory or other buildings.

The Eddy Electric Mfg. Co.,

WINDSOR, CONN.

NEW YORK, H. B. Coho & Co., Mail and Express Building.
PHILADELPHIA, Walter C. McIntire & Co., 506 Commerce St.
BOSTON, G. M. Angier & Co., 64 Federal St.
ELMIRA, S. N. Blake.
ST. LOUIS, Western Electrical Supply Co.
KANSAS CITY, W. T. Osborn.
CINCINNATI, O., Nevada Bldg., John A. Stewart.
CHICAGO, 305 Dearborn St., Wallace & Hine, Managers.
SAN FRANCISCO, CAL., Cal. Elec. Wks., 409 Market St.

THE CALIFORNIA ASPHALT CO. OF NEW YORK — ALCATRAZ ELECTRICAL COMPOUND

Alcatraz Electrical Compound,

Manufactured by

THE CALIFORNIA ASPHALT CO., 57 East 59th St., NEW YORK.

ABSOLUTELY UNEQUALED FOR

ELECTRICAL AND WIRE INSULATION, Insulating Connections, Dynamos and Motor Bases, Battery and Accumulator Shelving, Circuit and Switch-Boards.
WATER-PROOFING Cut-Out Boxes, coating wires when subjected to acid or alkaline fumes, and when laid under cement, etc.
PAINTING Poles, Brackets, Cross-Arms, Benches, Floors, etc.
COATING CABLES, Lead-Covered Pipes, and all underground work.

ALCATRAZ ELECTRICAL COMPOUND is manufactured of the celebrated brand of Alcatraz Asphalt, and possesses many well-known points of superiority. It has been tried under severe and exacting conditions, and has given perfect satisfaction. **It will not Scale, Crack or Burn. Presents a Smooth Surface. Adheres Tenaciously. Not affected by Thermal or Climatic Conditions. Resists the action of the Elements, Acids, Alkalies, Sewer Gases, and possesses great strength and elasticity.** Being the producers of the raw product, we are enabled to save the middleman's profit, and offer consumers a superior article at a very low price.

SAMPLE UPON APPLICATION. Agents wanted in all leading cities.

NOISELESS IN OPERATION.
A MONEY EARNER.

THE WARREN ALTERNATOR.

A machine of highest possible efficiency and correct regulation that will not burn out or require costly repairs.

A machine which, aside from a due regard to lubrication, may be put into the most severe service and let to run perpetually without attention of any sort; a dynamo of slow speed which meets all the conditions of the best of the well-known types of Alternators, but from which all hazard is eliminated.

The Modern Dynamo for Central Station Work.

WARREN ELECTRIC MANUFACTURING CO.,
SANDUSKY, OHIO.

Type "R" Instrument.

KEYSTONE ELECTRICAL INSTRUMENT COMPANY.

Switchboard Voltmeters, Ammeters, Ground Detectors and Differential Voltmeters.

We meet all the requirements of modern Central Stations or Isolated Plants, whether using direct or alternating current circuits.
Our Instruments are constant and durable, sensitive and accurate, pleasing in appearance and always correct.
We can interest you in prices and other details if you will write to

Ninth St. and Montgomery Ave., Philadelphia.
New York, 15 Cortlandt Street.
Chicago, 1440 Monadnock Building.

Primary Batteries for Every Purpose.

Our Closed Circuit Batteries are by far the most economical for the production of constant current.

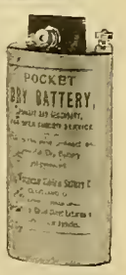
We combine all the desirable features of the most expensive batteries at one-half the cost. We positively guarantee them free from local action or deterioration while on open circuit. They have the highest E. M. F. and largest constant current discharge yet obtainable on closed circuit work. Extreme changes in temperature, 30° below zero, have no effect upon them.

They are the most compact and longest life batteries of this class, and are extensively used for Gas and Gasoline Engine Ignition, Railway Signals, Police and Fire Alarms, Etc.

Our specialties are 300 ampere-hour sealed screw top hard-rubber cells for Motor Wagons, and 600 ampere-hour batteries for Fan Motors. Write for prices, etc.

Dry Batteries three years in advance. We have made the greatest progress in the perfection of Dry Batteries. We lead, others follow.

Our batteries possess the highest degree of perfection, combined with valuable new features. A comparative test will convince the most skeptical that we manufacture the most powerful and longest life Dry Batteries yet produced. Their recuperative power is unequaled, and when reduced by long service can be recharged from any direct current, a storage feature not possessed by any other dry battery. Our 1900 Dry Battery is fully three years in advance of any battery of this class. Absolutely no local action when on open circuit.



Chloride of Silver Batteries. The advantages we claim for them are: Compactness, Efficiency, Constancy and Durability. They are put up in hard rubber cells and perfectly sealed, and are especially adapted for electrical measuring and testing, and are largely used on all forms of portable gas and gasoline engines, and all other service where a constant and uniform current is desirable. Contain a constant E. M. F. of 1.10 volt and a current of from 1 to 3 amperes.

The Nungesser Electric Battery Co.,

Manufacturers of Dry Batteries, Closed Circuit Batteries and Chloride of Silver Batteries,

18 HIGH ST., CLEVELAND, OHIO.

YOUR SUPPLY MAINTAINED FOR 12c.

LAMPS Efficient, Long-Lived and Guaranteed Satisfactory.

Write us before making another contract. We are **THE** Lamp Renewing Company you have heard of.

Lynn Incandescent Lamp Co., Lynn, Mass.

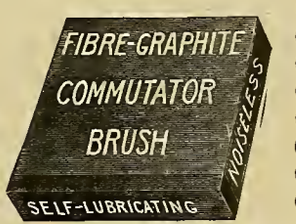
The Fibre-Graphite Commutator Brush.

(U. S. and Foreign Patents.)

No Sparking Under Varying Load.
No Wear on Commutator.
No Shifting of Quadrant.
80 per cent. Pure Graphite.

For Sample Order, and Prices, write to

Holmes Fibre-Graphite Mfg. Co.,
Station Z, Philadelphia.



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ARC LAMPS.

HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

American Carbon Co.'s

Plain and Coated Carbons for Series Arc Lighting.

GENERAL WESTERN AGENTS.

CHICAGO EDISON COMPANY,

DEALERS IN ELECTRIC LIGHTING SUPPLIES,

HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

139 Adams Street, CHICAGO.

THE ORIGINAL PATENTEES AND MANUFACTURERS OF

Cement-Lined Ducts

Engineers and Contractors for Complete Subways.

Address all Correspondence: **NEW HAVEN, CONN.**

The Connecticut Pipe Manufacturing Company,

Office and Factory, West Haven, Conn.

Business Established 1865.
Incorporated 1892.

E. H. PHIPPS, President.
GEO. O. RICHARDS, Secretary.
CHARLES WARD, Gen. Mgr.

- - THE - -

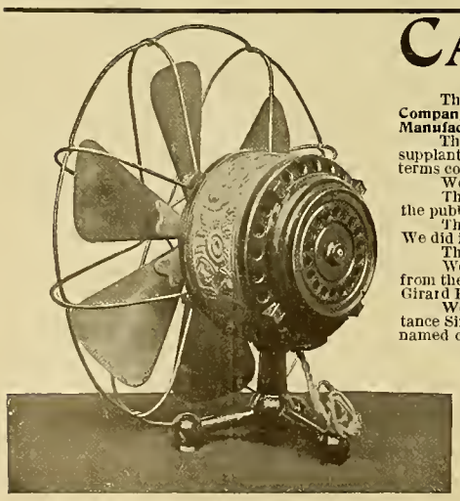
BRYANT-PAISTE SWITCH.

PRICES GREATLY REDUCED.

WRITE YOUR JOBBER FOR REVISED FIGURES.

THE BRYANT ELECTRIC CO.,

BRIDGEPORT, CONN. CHICAGO, ILL.



CARD TO THE PUBLIC.

The **General Electric Company, Westinghouse Electric Company, Thomson-Houston Electric Company** and the **Tesla Electric Company** have brought suits against the **Scott & Janney Electric & Manufacturing Company** for "alleged infringements" of their various patents.

This is the **USUAL "BLUFF"** that is brought to bear upon those whose inventions are bound to supplant the inventions of the above named and other large electrical concerns, who cannot at their own terms control such new inventions.

We are manufacturing under **our own patents and are not infringing.**

The above named firms are suing us upon a small fan motor as an excuse to get a chance to make the public believe that the state of the art is not history as far as they know it.

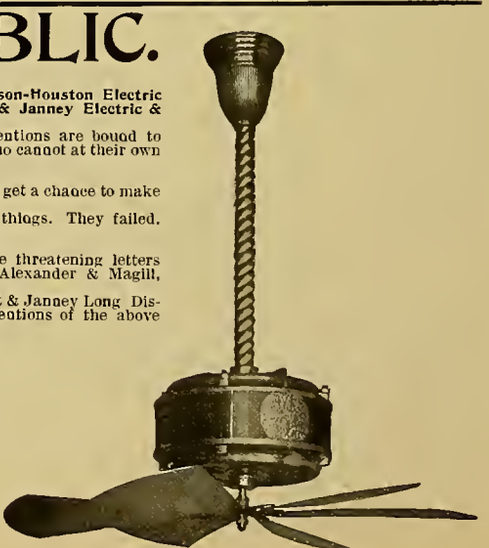
They have spent millions of dollars trying to invent apparatus to do certain things. They failed. We did invent it and have had it patented all over the world. **AND IT WORKS.**

They will try by strategy to do what they dare not do openly.

We wish to ask that the dealers and others who have received or will receive threatening letters from the above named concerns, will please send same to our attorneys, Messrs. Alexander & Magill, Girard Building, Philadelphia.

We are in the field to stay and do not propose to be intimidated. The Scott & Janney Long Distance Single Phase Alternating Railway and Power System will supersede the inventions of the above named companies. **AND THEY KNOW IT.**

FULL PROTECTION GUARANTEED TO ALL PURCHASERS OF OUR APPARATUS.



The Scott & Janney Electric and Mfg. Co.,

1707-1709 Filbert Street, PHILADELPHIA.

IF prosperity or increased business or better times is to be the actual result of all this talk, if there is a prospect of a realization after years of anticipation, it would seem to be a sensible proposition for everyone to fall in line and help push. If there are good things to be distributed we all want our share, but good things are not coming to anyone unless he gets out and hustles to secure them.

Years of decreased profits and increased competition have prevented many needful repairs and extensions, but it is "in the air" that the coming Fall and Winter will see an enormous impetus given the various electrical industries, and it behooves everyone to get ready for it.

We have that faith in present conditions that we are "stocking up" much heavier than ever before in anticipation of your Fall business; shall we be so favored?

Central Electric Company,

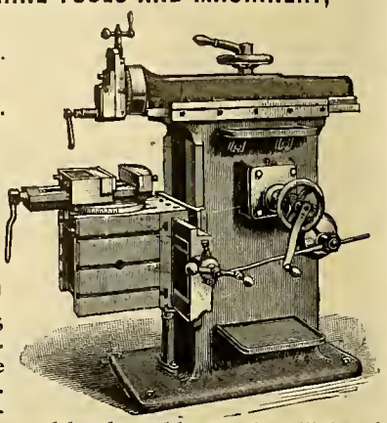
Geo. A. McKinlock, President. 1887-1897.
Charles E. Brown, Secretary.
S. R. Frazier, Treasurer. 173-175 Adams St., Chicago.

The Garvin Machine Co.,

MANUFACTURERS OF MACHINE TOOLS AND MACHINERY,

SPRING & VARICK STS., NEW YORK.
51 N. SEVENTH ST., PHILADELPHIA.

WESTERN AGENCY:
Fay & Egan Co., 22 S. Canal St., Chicago.



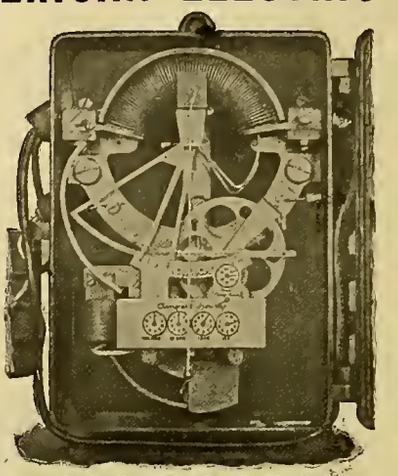
METAL WORKING MACHINERY.

Our facilities for equipping PLANTS engaged in the manufacture of ELECTRICAL goods are unquestionably the best of any concern in the country. We have in stock over 500 machines. Write us for No. 19 list of new and second-hand machinery. It will be of value to you.

THE AMERICAN ELECTRIC METER.

Designed for all Forms of Service.

Send for circulars and price lists.



3-Wire 22-Light Meter. Case Open, Showing Mechanism.

The . . . American Electric Meter Co.,

Cor. 9th Street and Montgomery Ave.,

PHILADELPHIA, PA.

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Arc Lamps.
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Puritan Electric Co.
Westinghouse El. & Mfg. Co.

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Gordon-Burnham Battery Co
Leclanche Battery Co., The.
Muir & Son, Thos.
Nungesser El. Battery Co.
Ohio Electric Works.
Peru Elec. Mfg. Co.

Bells.
Central Electric Co.
Commercial El. Supply Co.
Edwards & Co.
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Huebel & Manger.
Ohio Electric Works.
Partrick & Carter Co.

Belting.
Jewell Belting Co.
Maio Belting Co.
Peerless Rubber Mfg. Co.
Shultz Belting Co.

Boilers.
Clonbrook Steam Boiler Co.

Books, Electrical.
Electrician Publishing Co.

Brushes.
Central Electric Co.
Commercial El. Supply Co.
Holmes Fibre-Graphite Co.
Partridge Carbon Co.

Burglar Alarms.
Central Electric Co.
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Edwards & Co.
Electric Appliance Co.
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Cables, Electric (See Insulated Wires), **Copper, Sheet and Bar.**
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Eastern Electric Cable Co.
General Electric Co.
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New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

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Chicago Edison Co.
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Partridge Carbon Co.
Reisinger, Hugo.

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Brill Co., J. G.

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California Asphalt Co.
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Okonite Co.

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Warren Electric Mfg. Co.

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Peoples Electric Co.
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Point Marion Mfg. Co.

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Scott & Janney El. & Mfg. Co.
Triumph Electric Co.
United Elec. Imp. Co.
Wagner Elec. Mfg. Co.
Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

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Fuel Economizer Co.

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Globe Electric Heating Co.
Johns, H. W., Mfg. Co.

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Zamel Arc Light Meter Co.

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Central Electric Co.
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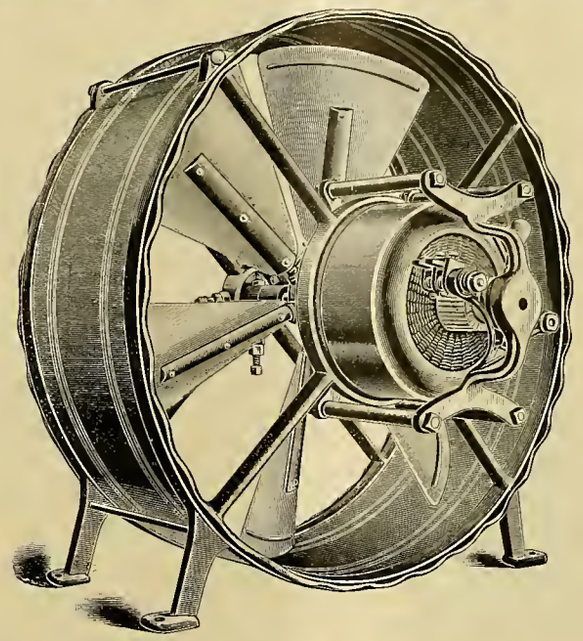

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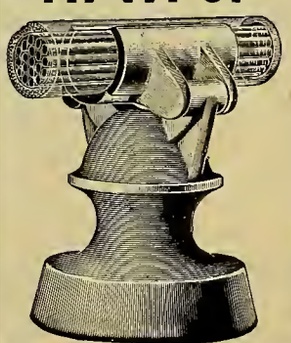

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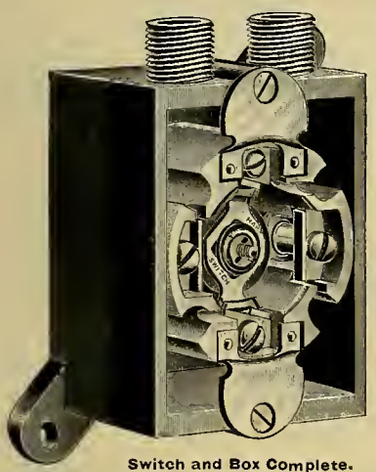

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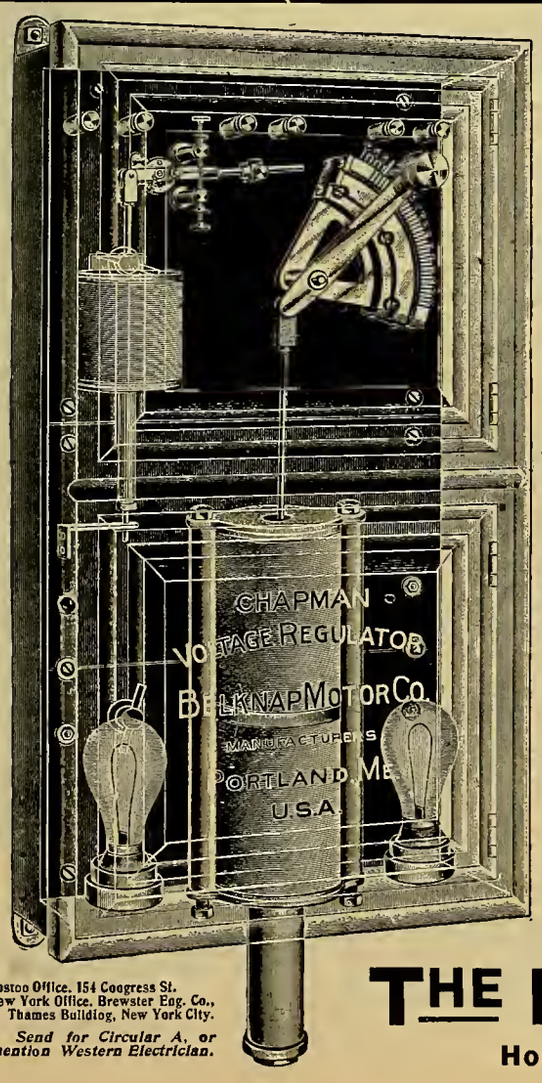

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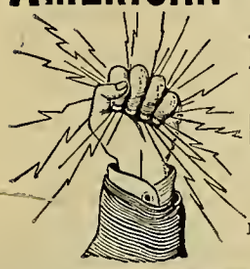

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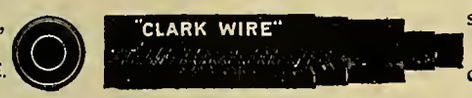

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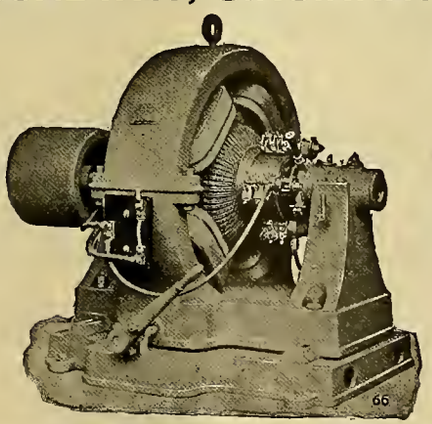

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BIDS WANTED.

The city of Asheville, N. C., desires bids for furnishing and maintaining one hundred to one hundred and fifty electric arc lights of two-thousand (2,000) candle power each.
The city reserves the right to reject any or all bids. Bids to be received until Sept. 20, 1897.
GEO. F. SCOTT, Chairman
Special Light Committee,
Asheville, N. C.

Proposals for Electric Lighting.

Sealed proposals are invited by the City Council of Gilman, Ill., for installing an electric light plant in connection with the water works plant of said city. The city will furnish power house, with a 60 h. p. boiler and pump, and will contract for 23 2,000 c. p. arc lights, all-night service, and pumping water. Franchise for a term of years will be granted for commercial and private lighting in said city. All bids opened Sept. 15. Particulars furnished upon application, the City Council reserving the right of rejecting any or all bids. Address C. P. Enright, Clerk, Gilman, Ill.

NOTICE TO BIDDERS.

Notice is hereby given that bids will be received by the Common Council of the City of Niagara Falls up to and including the first day of November, 1897, at 8 o'clock p. m., for the exclusive furnishing of electric arc lights to the City of Niagara Falls for a period of five years from November 1, 1898, according to specifications on file with the city clerk.

Each bid shall give the name and address of the bidder and shall state the price per annum for which the bidder will furnish each electric arc light of a two thousand (2,000) candle lamp power for said term.

The estimated number of arc lights to be furnished is three hundred (300) with the right of the Common Council of the said city to increase or decrease the said number as it may elect during said term.

The successful bidder will be required to enter into contract for the furnishing of such number of electric arc lights as may be required for such term at the price per annum named in its bid and to furnish bond in twenty thousand dollars ($20,000) for the faithful performance of said contract.

Each bidder must accompany his bid with a certified check for ten thousand dollars ($10,000) as a guarantee that he will enter into contract if the same is awarded to him.

Further information, if desired, will be furnished by the city clerk upon application.

All bids shall be opened at the meeting of the Common Council to be held Monday, November 1, 1897.

The Common Council reserves the right to reject any or all bids.

Dated August 16, 1897.

By order of the Common Council.
S. F. ARKUSH,
City Clerk.

LEGAL NOTICE.

STATE OF ILLINOIS, COUNTY OF COOK, SS.
In the County Court of Cook County.
In the matter of the Metropolitan Electric Company, Insolvent, 16,384.

Under an Order of Court entered in the above entitled cause, on the first day of September, 1897, sealed proposals for the purchase of the entire stock of merchandise now on hand, trade marks, patents, good will and business of the above named insolvent, which will be shown by the inventory on file in said cause, after deducting goods sold by the assignee herein under Order of Court, entered July 31, 1897, and not including, however, bills and accounts receivable, real estate and cash on hand, will be received by the undersigned as assignee at its office, 100 Washington, street, Chicago, Ill., on or before 12 o'clock noon of September 14, 1897.

Copies of the inventory of the said property can be examined and all information will be furnished by the undersigned as such assignee, and an inspection of the property can be had upon application to the undersigned at its office, 100 Washington street, Chicago, Ill., at any time prior to September 14, 1897, at 12 o'clock noon.

The terms of the sale of the property under said order are cash, and under the terms of said order said assignee will at 2 o'clock p. m. on the 14th day of September, 1897, present in open court all proposals or offers received by it for the purchase of said property, which said bids will thereupon be opened by the court, and additional bids for the said stock of merchandise, trade marks, patents, good will and business, as an entirety, will be received by said court.

The right is reserved to reject all proposals.

It is further ordered by the court that each bid for the purchase of the property be accompanied by a deposit, in currency or certified check, for ten per cent. (10 per cent.) of the purchase price, which shall be forfeited to the estate in case such party, if he becomes a buyer of said merchandise, fails to comply with his bid and proposal and fails to pay the amount due for said merchandise in six (6) days thereafter.

CHICAGO TITLE AND TRUST COMPANY,
Assignee of the Metropolitan Electric Company, Insolvent,
By HENRY W. LEMAN, Second Vice-President.
LOUIS SPAHN, Attorney for Assignee.

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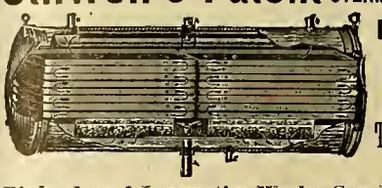

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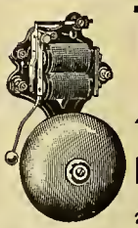

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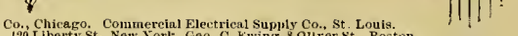

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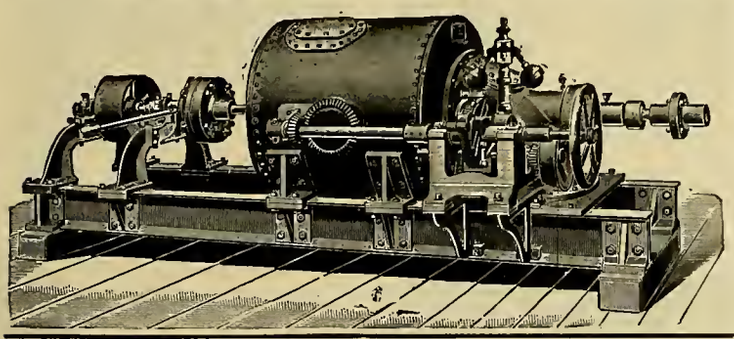

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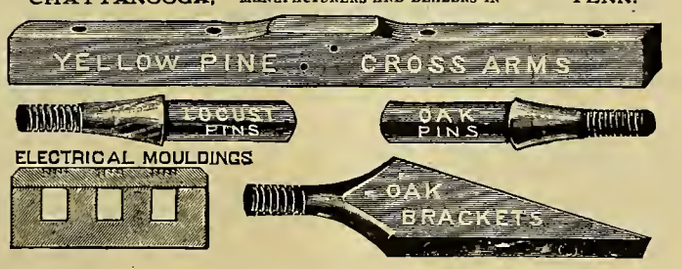

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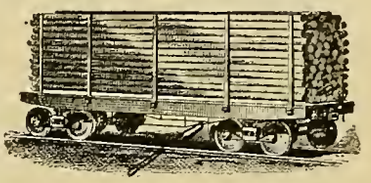

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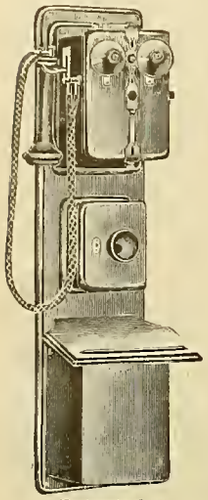

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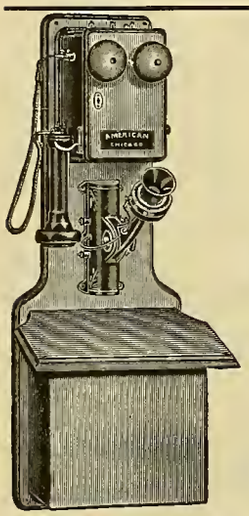

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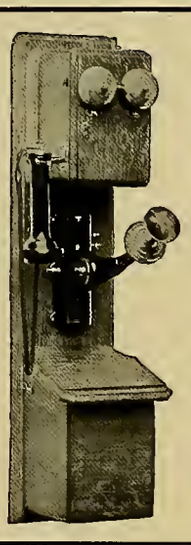

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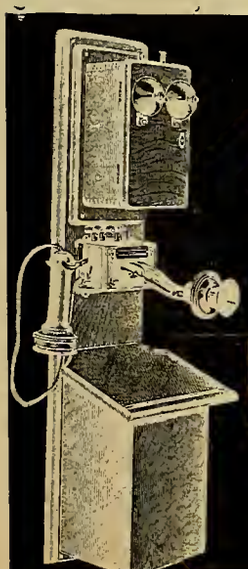

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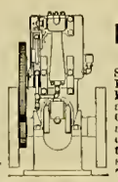

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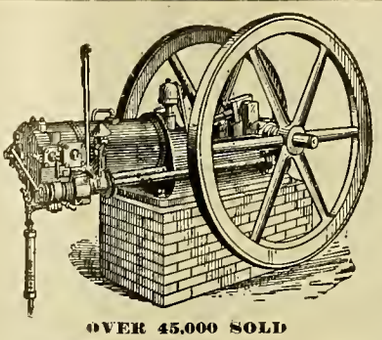

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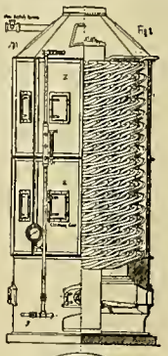

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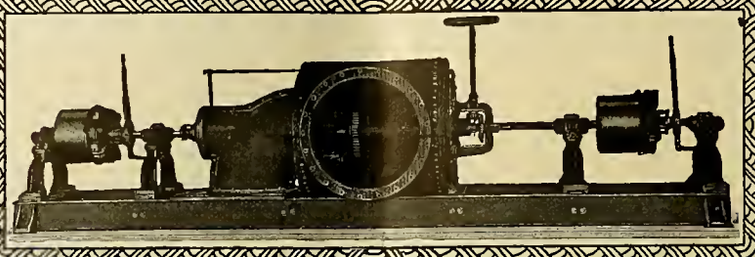

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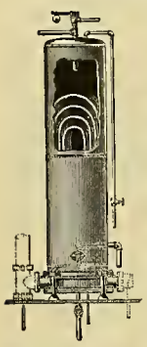

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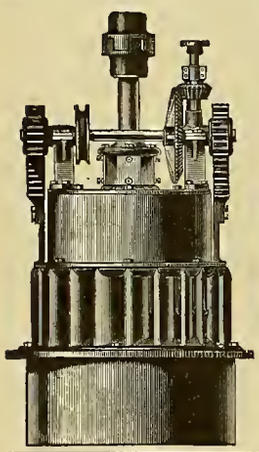

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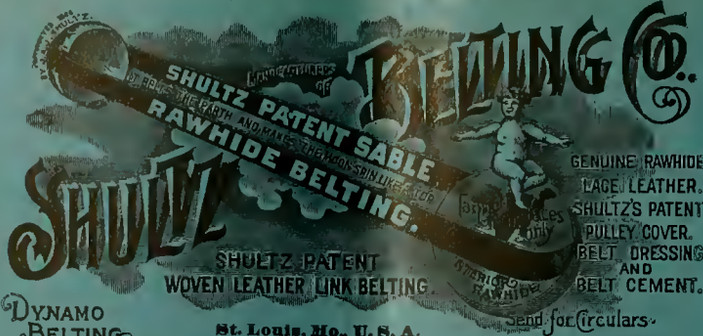

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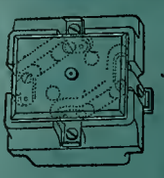

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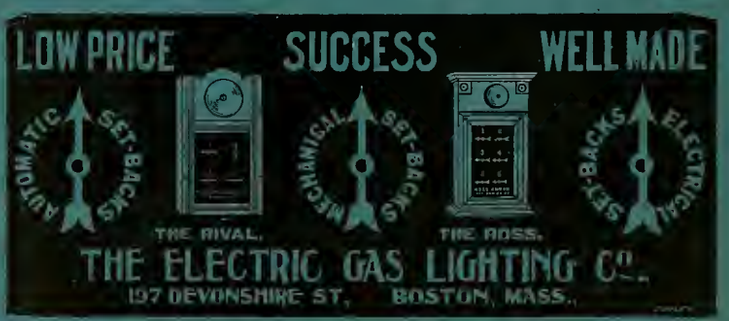

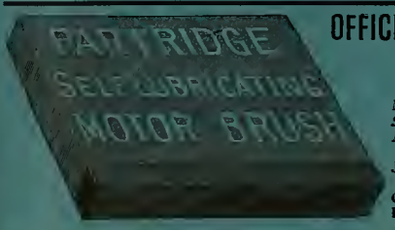

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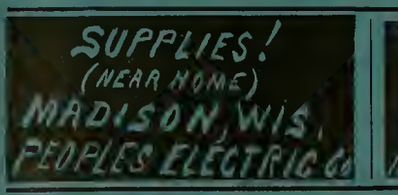

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ELECTRICAL AND WIRE INSULATION, Insulating Connections, Dynamos and Motor Bases, Battery and Accumulator Shelving, Circuit and Switch-Boards.
WATER-PROOFING Cut-Out Boxes, coating wires when subjected to acid or alkaline fumes, and when laid under cement, etc.
PAINTING Poles, Brackets, Cross-Arms, Benches, Floors, etc.
COATING CABLES, Lead-Covered Pipes, and all underground work.

ALCATRAZ ELECTRICAL COMPOUND is manufactured of the celebrated brand of Alcatraz Asphalt, and possesses many well-known points of superiority. It has been tried under severe and exacting conditions, and has given perfect satisfaction. **It will not Scale, Crack or Burn. Presents a Smooth Surface. Adheres Tenaciously. Not affected by Thermal or Climatic Conditions. Resists the action of the Elements, Acids, Alkalies, Sewer Gases, and possesses great strength and elasticity.** Being the producers of the raw product, we are enabled to save the middleman's profit, and offer consumers a superior article at a very low price.

SAMPLE UPON APPLICATION. Agents wanted in all leading cities.

Westinghouse Polyphase Apparatus Supreme.

Generators, Motors, Transformers, for Two-Phase, Three-Phase and C. F. Scott Two-Phase Three-Phase System of Alternating Current Power Transmission.

26,000 H. P. IN OIL-INSULATED TRANSFORMERS CONSTRUCTED.

Potentials from 5,000 to 50,000 Volts. All Apparatus Necessary for 100 Mile Transmission.

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.,

PITTSBURG, PA.

New York, 120 Broadway.
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Charlotte, N. C., 36-38 College St.
Chicago, N. Y. Life Bldg.
Philadelphia, Girard Bldg.
Pittsburg, Westinghouse Bldg.
St. Louis, American Central Bldg.
San Francisco, Mills Bldg.
Syracuse, N. Y., Bastable Bldg.
Tacoma, Wash., 102 S. 10th St.
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Westinghouse Electric Co., Ltd., 32 Victoria St., London, S.W., England.
For Canada address Ahearn & Soper, Ottawa, Ont.

NOISELESS IN OPERATION.
A MONEY EARNER.

SIMPLICITY AND DURABILITY IN DESIGN.

THE WARREN ALTERNATOR.

MASSIVE AND HEAVY
BUT EXTREMELY COMPACT.

A Dynamo without Collector Rings or Commutator, without Brushes, without Moving Wires, without liability to "burn out."

Made for continuous runs without attention, and proportioned to run up to an enormous overload without wasting energy in heating any part.

The Modern Dynamo for Central Station Work.

WARREN ELECTRIC MANUFACTURING CO.,
SANDUSKY, OHIO.

From the Torch to the "PIONEER" Enclosed Arc Light, the world has gradually advanced through all the stages of improving illumination until now we are practically delivering artificial sunshine. Steady, Clear, Soft, Shadowless, Simple, Economical and Safe.

IN WRITING FOR OUR CATALOGUE, KINDLY MENTION THIS PAPER.

THE ELECTRIC ARC LIGHT CO.,

687 AND 689 BROADWAY,

LOUIS B. MARKS, M. M. E., CHIEF ELECTRICIAN.

. . . . NEW YORK.

PIONEERS IN ENCLOSED ARC LIGHTING — THE PIONEER — TRADE MARK

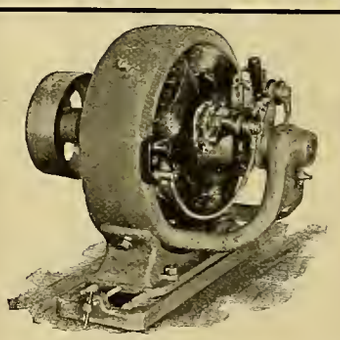
150 HOURS.

YOUR SUPPLY MAINTAINED FOR 12c.

LAMPS Efficient, Long-Lived and Guaranteed Satisfactory.

Write us before making another contract. We are THE Lamp Renewing Company you have heard of.

Lynn Incandescent Lamp Co., Lynn, Mass.



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DYNAMOS,

15 to 1,000 Lights.

MOTORS,

½ to 50 H. P. ANY VOLTAGE.

Patented Adjustable Dynamos and Motors for Floor, Wall or Ceiling.

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CLEVELAND, OHIO.

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HARDTMUTH CORED CARBONS for Direct and Alternating Current ARC LAMPS.

HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

AMERICAN CARBON CO.'S Plain and Coated CARBONS FOR SERIES ARC LIGHTING.

GENERAL WESTERN AGENTS.

HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

Chicago Edison Co.,

DEALERS IN ELECTRIC LIGHTING SUPPLIES,

139 Adams Street, CHICAGO.

THE ORIGINAL PATENTEES AND MANUFACTURERS OF

Cement-Lined Ducts

Engineers and Contractors for Complete Subways.

Address all Correspondence: **NEW HAVEN, CONN.**

The Connecticut Pipe Manufacturing Company,

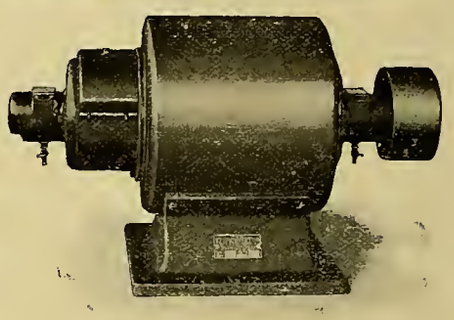
Office and Factory, West Haven, Conn.

Business Established 1865.
Incorporated 1892.

E. H. PHIPPS, President.
GEO. O. RICHARDS, Secretary.
CHARLES WARD, Gen. Mgr.

THE . . .

Storey Motors.



Iron-clad. Completely Closed In. Dust and Moisture Proof. No External Magnetism.

Specially Adapted for Direct Connection to Machinery.

Special Direct Current Motors for All Classes of Work.

THE STOREY MOTOR & TOOL CO.,

MAIN OFFICE AND FACTORY: 212-226 Carter St., Philadelphia, Pa.

BRANCH FACTORY: Hamilton, Canada.

TRIMMER'S TOWER WAGON.

Highly Endorsed.

Studebaker Bros. Mfg. Co.

Gentlemen:—In reply to your inquiry as to the advantage in the use of Light Tower Wagons, which you constructed by my request, to be used in trimming the arc lamps which are distributed throughout the parks and boulevards of the West Chicago park system, I will say that we have purchased six of these wagons and they have proven to be everything anticipated. I have had two trimmers taking care of 600 arc lamps per day of eight hours. The trimmers would trim and clean the lamps and keep them in satisfactory condition without any difficulty, and this has been done when the thermometer was below zero. In the use of the wagon on smooth roads it is not necessary to have an extra driver, the horse soon becomes so well trained that he will stop before each lamp pole by a simple command from the trimmer. I consider the Tower Wagon, as a means of trimming arc lamps, to be much cheaper than the old way of trimming by the use of ladders.

Yours truly, FOREE BAIN.

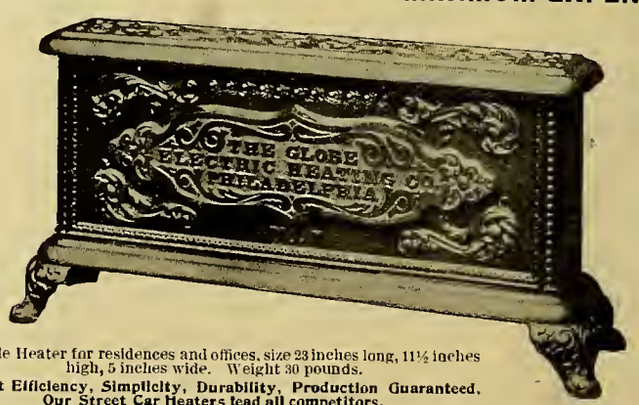
Chicago, July 6, 1897.

Write for detailed description.

STUDEBAKER BROS. MFG. CO.,

SOUTH BEND, IND.

ELECTRIC HEATERS AVAILABLE TO ALL. MINIMUM EXPENSE.



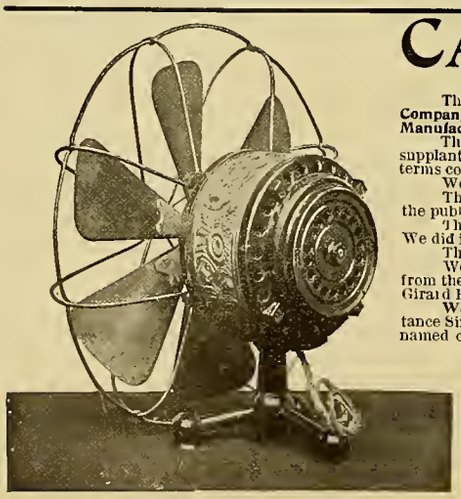
Portable Heater for residences and offices, size 23 inches long, 11½ inches high, 5 inches wide. Weight 30 pounds.

Highest Efficiency, Simplicity, Durability, Production Guaranteed. Our Street Car Heaters lead all competitors.

Send for new illustrated circular.

Heating coils renewed like incandescent lamps. Constructed for any voltage. Work on direct or alternating current. Consumes 6. 8 amperes on 110 volt current, 1. 5 on 500 volt current.

THE GLOBE ELECTRIC HEATING CO., 147 North 12th Street, Philadelphia, Pa.



CARD TO THE PUBLIC.

The **General Electric Company, Westinghouse Electric Company, Thomson-Houston Electric Company** and the **Tesla Electric Company** have brought suits against the **Scott & Janney Electric & Manufacturing Company** for "alleged infringements" of their various patents.

This is the **USUAL "BLUFF"** that is brought to bear upon those whose inventions are bound to supplant the inventions of the above named and other large electrical concerns, who cannot at their own terms control such new inventions.

We are manufacturing under **our own patents and are not infringing.**

The above named firms are suing us upon a small fan motor as an excuse to get a chance to make the public believe that the state of the art is not history as far as they know it.

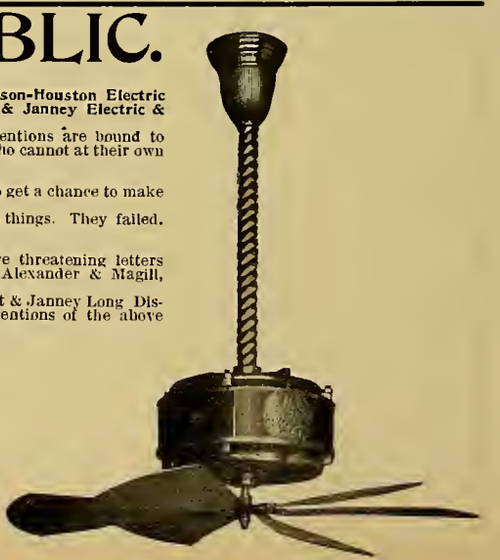
They have spent millions of dollars trying to invent apparatus to do certain things. They failed. We did invent it and have had it patented all over the world. **AND IT WORKS.**

They will try by strategy to do what they dare not do openly.

We wish to ask that the dealers and others who have received or will receive threatening letters from the above named concerns, will please send same to our attorneys, Messrs. Alexander & Magill, Girard Building, Philadelphia.

We are in the field to stay and do not propose to be intimidated. The Scott & Janney Long Distance Single Phase Alternating Railway and Power System will supersede the inventions of the above named companies. **AND THEY KNOW IT.**

FULL PROTECTION GUARANTEED TO ALL PURCHASERS OF OUR APPARATUS.



The Scott & Janney Electric and Mfg. Co.,

1707-1709 Filbert Street, PHILADELPHIA.

HERE'S A LIST FOR PARTICULAR AND PROGRESSIVE BUYERS.

THERE MUST BE SOME-THING HERE THAT YOU NEED.

Okonite Wire,
Interior Conduit (Iron and Brass),
Helios Arc Lamps (100 and 150 hour, direct and alternating),
Sawyer-Man Incandescent Lamps,
Wagner Transformers,
Banner Weather-proof Wire,
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Railway Supplies,
Queen-Wirt Instruments (Portable and Switchboard),
Scheeffer Wattmeters,
Lundell Power Motors,
Lundell Fan Motors,
Station Switches—
Anything and Everything Electrical.

Check off the articles you need and let us make you quotations.

OKONITE
IT NEVER DISAPPOINTS

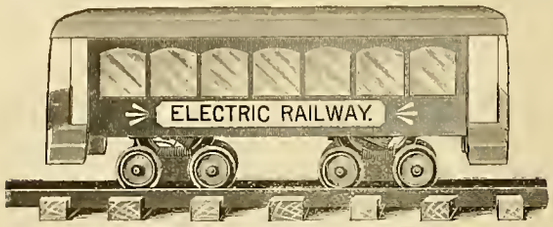
Central Electric Company,

(1887-1897.)

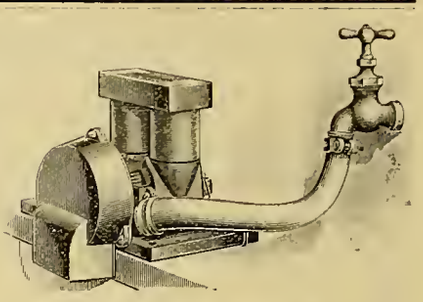
Geo. A. McKinlock, Prest.
Charles E. Brown, Secy.
S. R. Frazier, Treas.

173-175 Adams Street, Chicago.

ELECTRICAL TOYS.



Large Double Track Car, Track, etc. . $6.50
Water Motor and Dynamo 8.00



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ST. LOUIS ELEC. SUP. CO., 911 Market St., St. Louis, Mo.
NATIONAL AUTOMATIC FIRE ALARM CO., New Orleans, La.

THE CARLISLE & FINCH CO., 832 West Sixth St., CINCINNATI, OHIO.

W. S. HILL ELECTRIC CO., New Bedford, Mass.

Send for Catalogue.

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Central Electric Co., Chicago.

SWITCH BOARDS.
SWITCHES AND PANEL BOARDS.

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Central Electric Co.
Electric Storage Battery Co.
N. Y. Acc. & El. Co.
Ohio Storage Battery Co.
Willard El. & Battery Co.

Annunciators.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Partrick & Carter Co.

Arc Lamps.
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Commercial El. Supply Co.
Diehl Mfg. Co.
Electric Arc Light Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Manhattan Gen'l Cons. Co.
Peoples Electric Co.
Puritan Electric Co.
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Central Electric Co.
Samson Cordage Wks.

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Electric Appliance Co.
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Leclanche Battery Co., The.
Muir & Son, Thos.
Nungesser El. Battery Co.
Ohio Electric Works.
Peru Elec. Mfg. Co.

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Electric Appliance Co.
Huebel & Manger.
Ohio Electric Works.
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Electrician Publishing Co.

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Holmes Fibre-Graphite Co.
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Electric Appliance Co.
Huebel & Manger.
Partrick & Carter Co.

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Cables, Electric (See Insulated Wires), **Copper, Sheet and Bar.**
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Eastern Electric Cable Co.
General Electric Co.
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New York Ins. Wire Co.
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Washburn & Moen Mfg. Co.

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Electric Appliance Co.
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Partridge Carbon Co.
Reisinger, Hugo.

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Brill Co., J. G.

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Mass. Chemical Co.
McLennan & Co., K.
Okonite Co.

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Conn. Pipe Mfg. Co.
Electric Appliance Co.
Interior Conduit & Ins. Co.
Muir & Son, Thos.

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Elliott, W. H. Elec. Co.
Ft. Wayne Elec. Corporation.
Hodge, Walsh & Loring.
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McFell Electric Co.
McRae, A. L.
Thordarson, C. H.
United Elec. Imp. Co.
Wagner Elec. Mfg. Co.
Warren Electric Mfg. Co.

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Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hodge, Walsh & Loring.
Keystone Electric Co.
McRae, A. L.
Northern Electl. Mfg. Co.
Peoples Electric Co.
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Triumph Electric Co.
United Elec. Imp. Co.
Wagner Elec. Mfg. Co.
Warren Electric Mfg. Co.
Westinghouse Elec & Mfg Co.

Copper.
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Central Electric Co.
Mansfield Temp. Copper Co.
Mitchell Temp. Copper Co.

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American Electrical Works.
Besly & Co., Chas H.
Brixey, W. R.
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Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
General Electric Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

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Central Electric Co.
Samson Cordage Wks.

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Central Electric Co.
Central Mfg. Co.
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Point Marion Mfg. Co.

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Bryant Electric Co.
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Cutter El. & Mfg. Co.
Eddy Elec. Mfg. Co.
Electric Appliance Co.
Emerson El. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Elec. Co.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Palste Co., H. T.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Wagner Elec. Mfg. Co.
Westinghouse El. & Mfg. Co.

Dynamos.
Ahlm-Edwards El. Co.
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Central Electric Co.
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Evans Electric Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Keystone Electric Co.
Muir & Son, Thos.
Northern Electl. Mfg. Co.
Scott & Janney El. & Mfg. Co.
Triumph Electric Co.
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Wagner Elec. Mfg. Co.
Warner, Wm. F.
Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Fual Economizer Co.

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Globe Electric Heating Co.
Johns, H. W., Mfg. Co.

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Pratt, Chas. A.

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Carliste & Finch Co.
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Commercial El. Supply Co.
Hill, W. S. Electric Co.
Palste Co., H. T.
Peru Elec. Mfg. Co.
Splitdorf, C. F.
Thordarson, C. H.
Vought, M. I.

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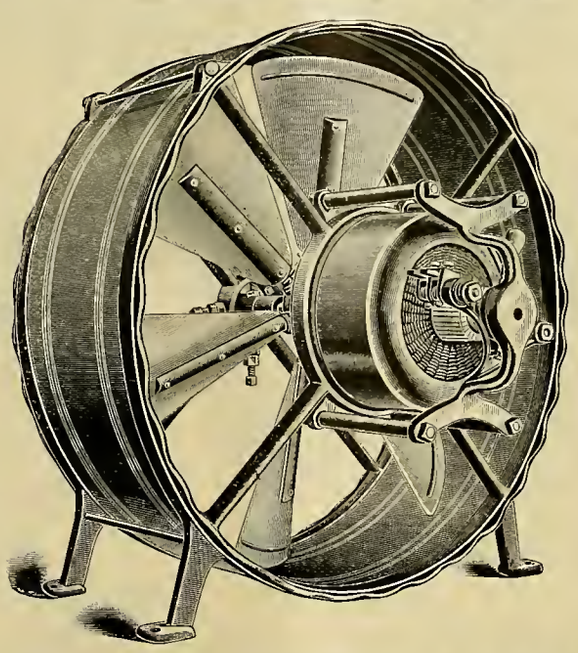

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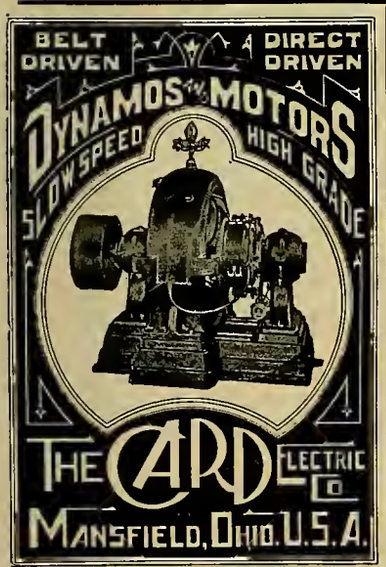

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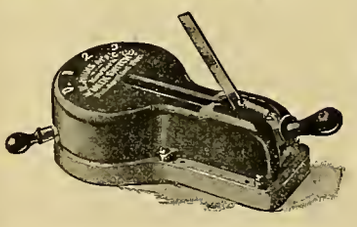

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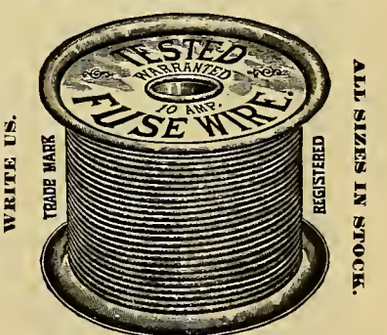

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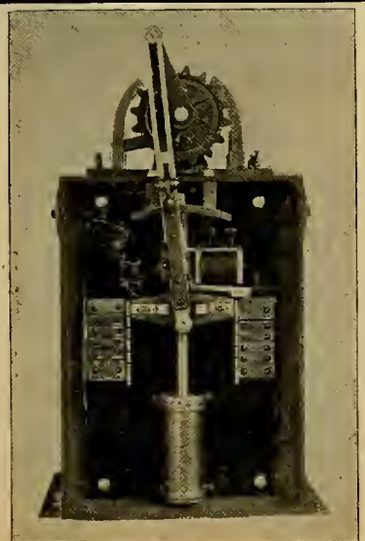

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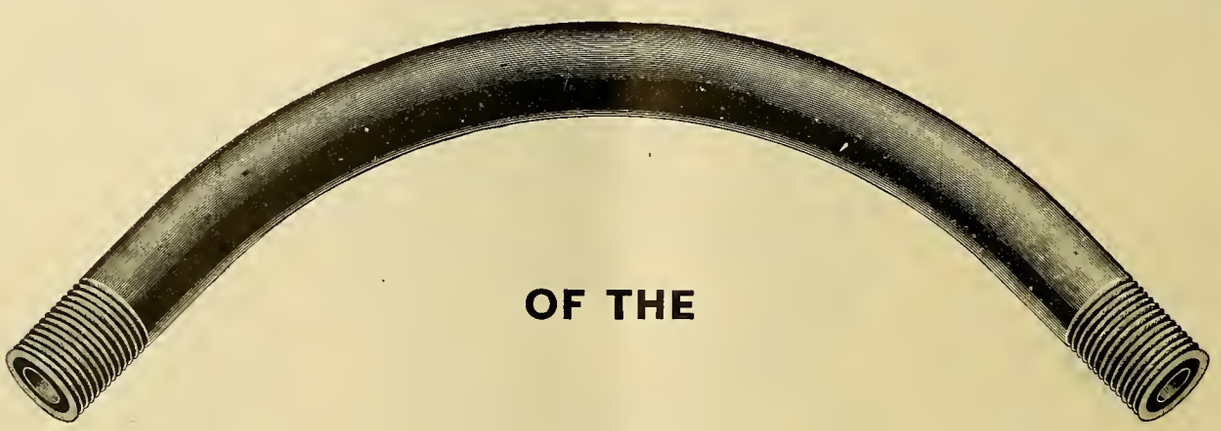

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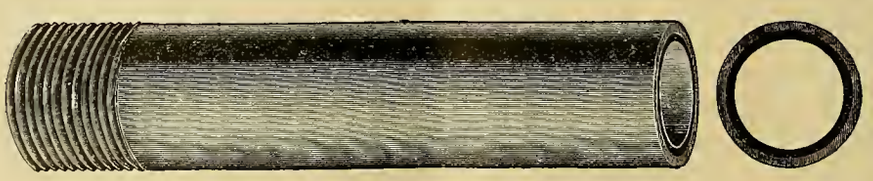

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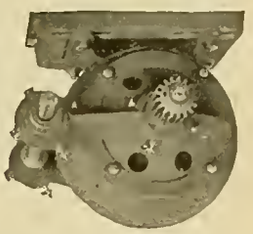

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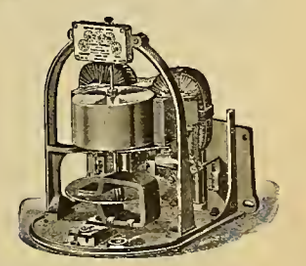

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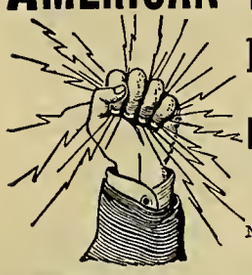

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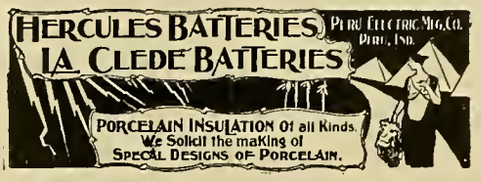

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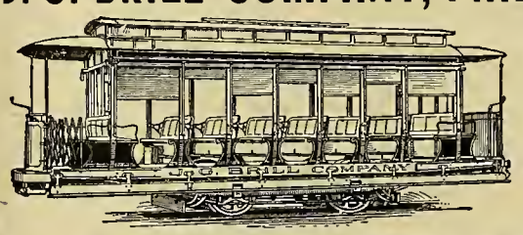

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BIDS WANTED.

The city of Asheville, N. C., desires bids for furnishing and maintaining one hundred to one hundred and fifty electric arc lights of two-thousand (2,000) candle power each.

The city reserves the right to reject any or all bids. Bids to be received until Sept. 20, 1897.

GEO. F. SCOTT, Chairman,
Special Light Committee,
Asheville, N. C.

DYNAMOS

For Lighting and Plating.

20 light.....$ 40 00
50 light..... 75.00
100 light..... 125.00

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¼ h. p., $15; ½ h. p., $25; 1 h. p., $40; 2 h. p., $60. Storage batteries and propeller wheels for boats.

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(See next week's ad. for list of storage batteries.)

STATE OF ILLINOIS, COUNTY OF COOK, SS.

In the County Court of Cook County.

In the matter of the Metropolitan Electric Company, Insolvent, No. 16,384.

Under an order of Court, entered in the above entitled cause on the 9th day of September, A. D. 1897, sealed proposals for the purchase of the book accounts and bills receivable, stock shares and all other property of every name and nature (exclusive of orders currently received and cash on hand) not designated and comprehended in the order herein made on the 1st day of September, A. D. 1897, will be received by the undersigned, as assignee, at its office, 100 Washington street, Chicago, Ill., on or before 12 o'clock, noon, September 24th, A. D. 1897. A list of the said accounts and bills receivable, stock shares, etc., can be examined and all information will be furnished by the undersigned, as such assignee, on application to its office, 100 Washington street, Chicago, Ill., at any time prior to September 24th, A. D. 1897, at 12 o'clock, noon.

The terms of the sale of the said accounts and bills receivable and stock shares under said order are cash, and under the terms of said order said assignee will, at 2 o'clock p. m. on the 24th day of September, A. D. 1897, present in open court all proposals or offers received by it for the purchase of said property, which bids will be opened by the said Court, and additional bids for the said accounts and bills receivable and stock shares will be received by said Court.

The right is reserved to reject all bids and proposals.

It is further ordered by the Court that each bid for the purchase of the property be accompanied by a deposit in currency or certified check for ten per cent. of the amount bid, which shall be forfeited to the estate in case such party becomes buyer of such merchandise and fails to comply with his bid and proposal and fails to pay the amount due for said property in six (6) days thereafter.

CHICAGO TITLE AND TRUST COMPANY
Assignee of the Metropolitan Electric Co.
By HENRY W. LEMAN, Second Vice-President.
LOUIS SPAHN, Attorney for Assignee.

To Steam, Electrical and Plumbing Contractors.

Sealed proposals will be received up to 11 a. m., Tuesday, September 28, for furnishing all the material and doing all the labor in connection with the steam heating, electrical wiring, etc., for the Illinois Western Hospital for the Insane, Watertown, Rock Island Co., Ill. All to be in accordance with specifications on file in office of F. W. Gould, President Board of Trustees, Moline, Ill.; also at the office of the Consulting Engineer, Charles G. Armstrong, 1306 Great Northern Building, Chicago, and at the office of the architect, M. E. Bell, Dexter Building, Chicago, which plans and specifications may be seen on or after September 21.

Each proposal must be accompanied by a certified check for 2 per cent. of the amount of the bid, payable to the order of F. W. Gould, President, to be forfeited to the State of Illinois in case the bidder or bidders chosen fail to enter into a contract with the Board and furnish a satisfactory bond for the proper execution of the same within ten days after the acceptance of their proposals.

Each bidder must be prepared to give a satisfactory bond guaranteeing to fully pay for all labor and material used in this work.

Bids must be sealed and addressed to the undersigned, and upon the envelope must appear the name and address of the bidder, and marked Proposal for Steam Heating, Electrical Wiring and Plumbing for the Illinois Western Hospital for Insane, Watertown, Ill.

The Board of Trustees reserve the right to reject any or all bids or to accept any bid or combination of bids which the Board may deem to their advantage.

By order of the Board of Trustees,
F. W. GOULD, President.
Moline, Ill., Sept. 16, 1897.

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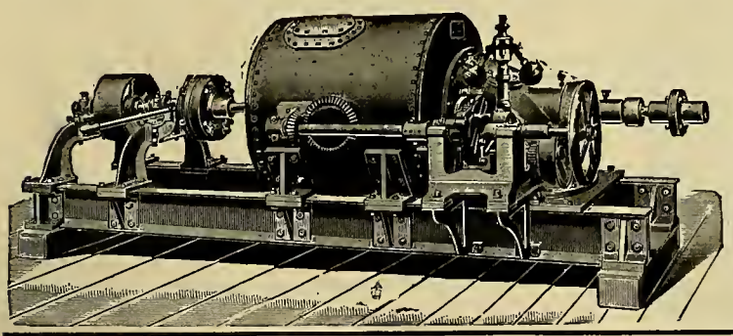

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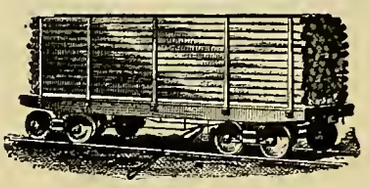

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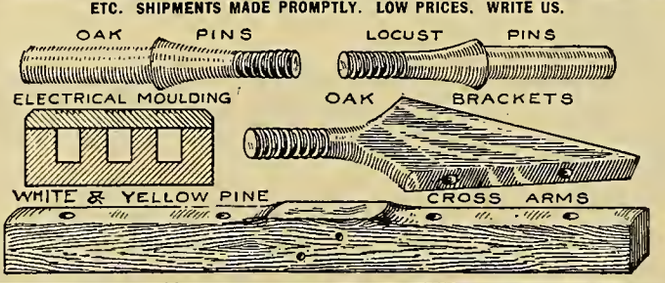

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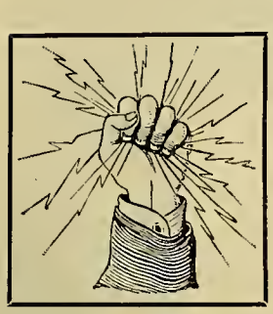

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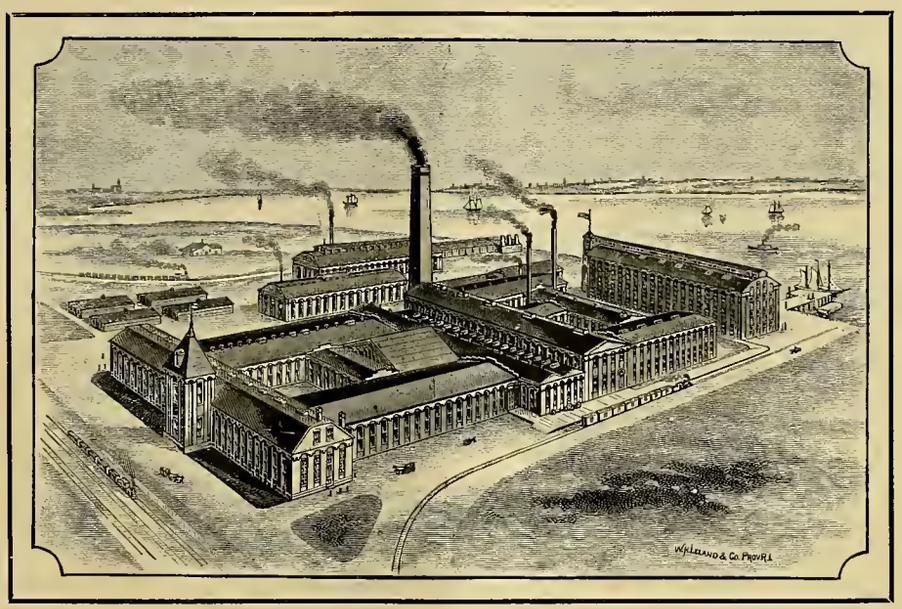

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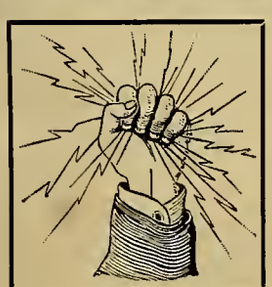

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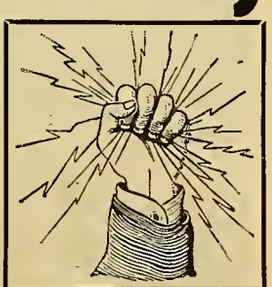

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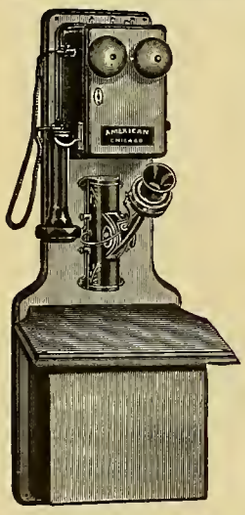

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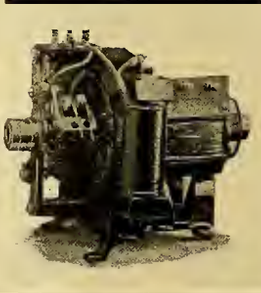

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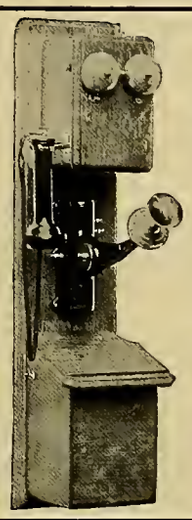

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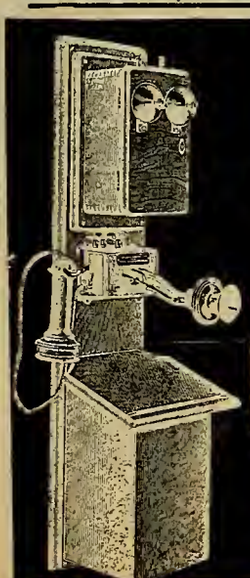

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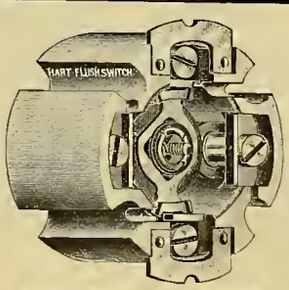

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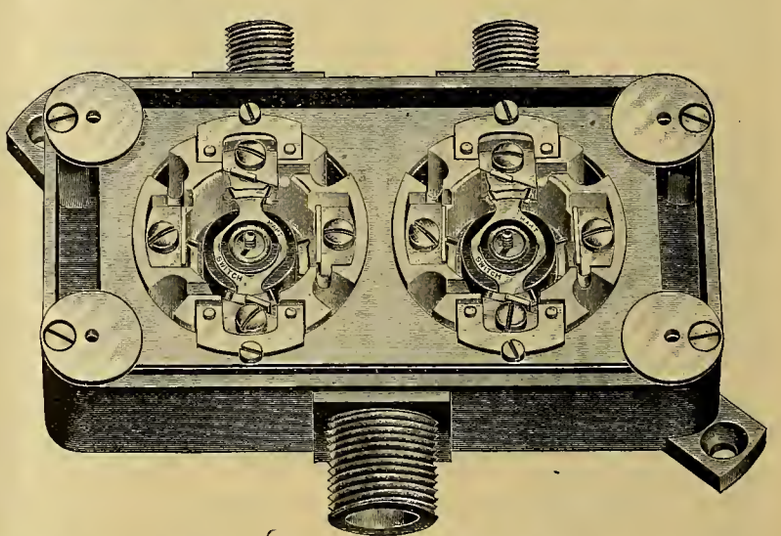

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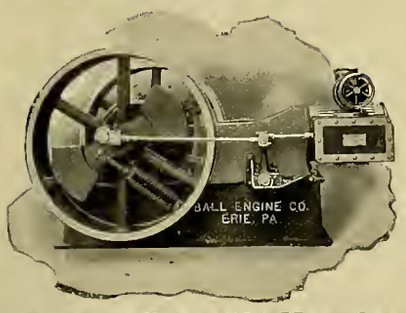

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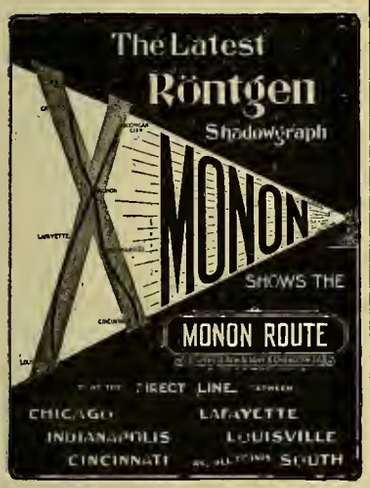

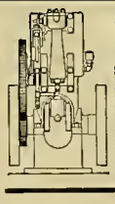

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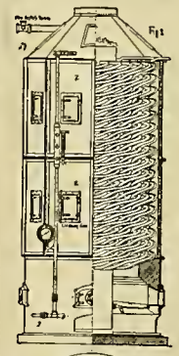

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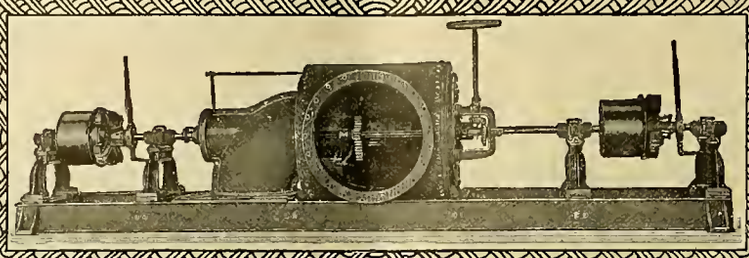

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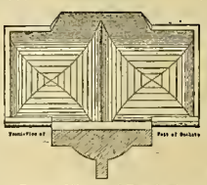

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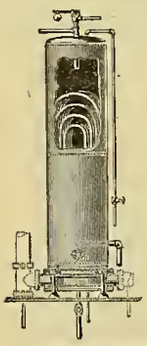

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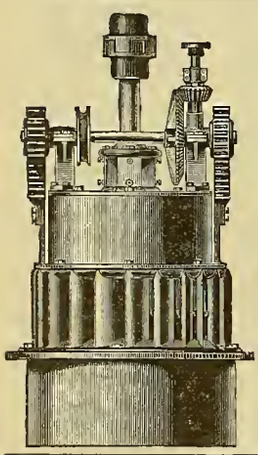

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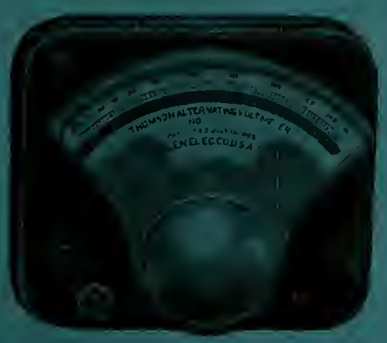

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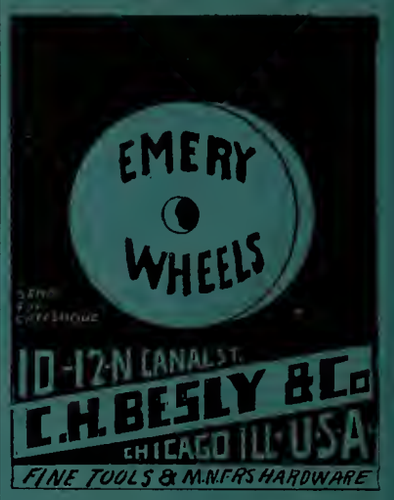

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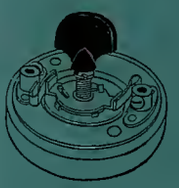
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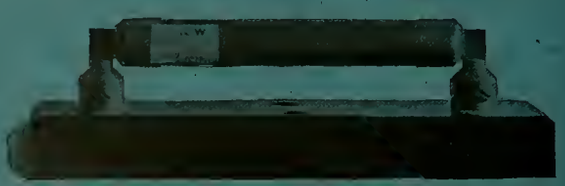
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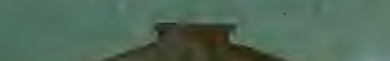

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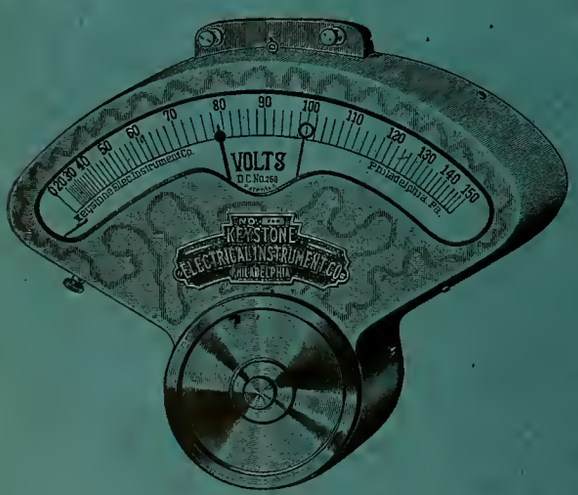
SAMPLE UPON APPLICATION. Agents wanted in all leading cities.



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KEYSTONE ELECTRICAL INSTRUMENT COMPANY.

Switchboard Voltmeters, Ammeters, Ground Detectors and Differential Voltmeters.

We meet all the requirements of modern Central Stations or Isolated Plants, whether using direct or alternating current circuits.
Our Instruments are constant and durable, sensitive and accurate, pleasing in appearance and always correct.
We can interest you in prices and other details if you will write to

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What would you think of a machine that we could set down in your plant, belt up to power, turn it over and tell your dynamo "tender" to keep away and let it run without attention?
Pretty good thing?
Well, we can do just that with the

MAKES NO NOISE.
MAKES MONEY.

WARREN INDUCTION ALTERNATOR.

Only needs oil in the reservoirs. It has no collector rings. No commutator to grind away, wear out, short circuit, get hot, full of holes, loose bars, etc., etc., and no brushes, no moving wires to scrape insulation, break joints and fly off at a tangent. It has none of the above evils.

Can we tell you some of the GOOD POINTS by mail?
Write and let us try. Illustrated Circulars.

Warren Electric Manufacturing Co.,

SANDUSKY, OHIO.

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IN DESIGN IS NOT THE ONLY IMPORTANT FEATURE OF THE ROTH HIGH GRADE DYNAMOS & MOTORS. THEY HAVE MANY OTHER FEATURES WHICH CONVINCE BUYERS OF THEIR SUPERIORITY LET US SEND YOU FURTHER PARTICULARS.

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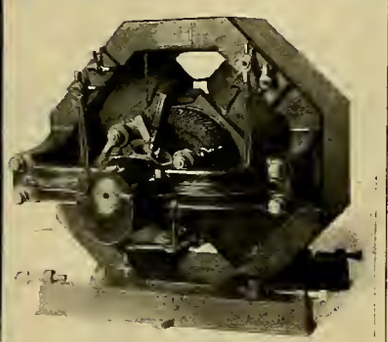
E. C. Van Nort Electric Co., St. Louis, Mo.
N. Y. Dynamo and Motor Co., New York City.
H. K. Greenman, Sioux City, Ia.



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PERU, IND.

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Known for 10 Years as McCreary Standard Reflector Shades.

We are prepared to furnish them in quantities to suit. Any color top desired. Prompt shipments. Reflectors for Welsbach and any Argand gas lamp.

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The *Electrical Power and Lighting Scholarship* is intended for Installation Engineers, Managers of Electric Plants, Dynamo Tenders, Linemen, Wiremen, Motormen, Steam Engineers and workers in electrical industries who desire to qualify themselves to install and operate electrical machinery.

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YOUR SUPPLY MAINTAINED FOR 12c.

LAMPS Efficient, Long-Lived and Guaranteed Satisfactory.

Write us before making another contract. We are THE Lamp Renewing Company you have heard of.

Lynn Incandescent Lamp Co., Lynn, Mass.

The Fibre-Graphite Commutator Brush.

(U. S. and Foreign Patents.)

No Sparking Under Varying Load.
No Wear on Commutator.
No Shifting of Quadrant.
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Station Z, Philadelphia.

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HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

AMERICAN CARBON CO.'S Plain and Coated CARBONS FOR SERIES ARC LIGHTING.

GENERAL WESTERN AGENTS.

HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

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DEALERS IN ELECTRIC LIGHTING SUPPLIES,

139 Adams Street, CHICAGO.

- - THE - -

BRYANT-PAISTE SWITCH.

PRICES GREATLY REDUCED.

WRITE YOUR JOBBER FOR REVISED FIGURES.

THE BRYANT ELECTRIC CO.,

BRIDGEPORT, CONN. CHICAGO, ILL.

TRIMMER'S TOWER WAGON.

Highly Endorsed.

Studebaker Bros. Mfg. Co.

Gentlemen:—In reply to your inquiry as to the advantage in the use of Light Tower Wagons, which you constructed by my request, to be used in trimming the arc lamps which are distributed throughout the parks and boulevards of the West Chicago park system, I will say that we have purchased six of these wagons and they have proven to be everything anticipated. I have had two trimmers taking care of 600 arc lamps per day of eight hours. The trimmers would trim and clean the lamps and keep them in satisfactory condition without any difficulty, and this has been done when the thermometer was below zero. In the use of the wagon on smooth roads it is not necessary to have an extra driver, the horse soon becomes so well trained that he will stop before each lamp pole by a simple command from the trimmer. I consider the Tower Wagon, as a means of trimming arc lamps, to be much cheaper than the old way of trimming by the use of ladders.

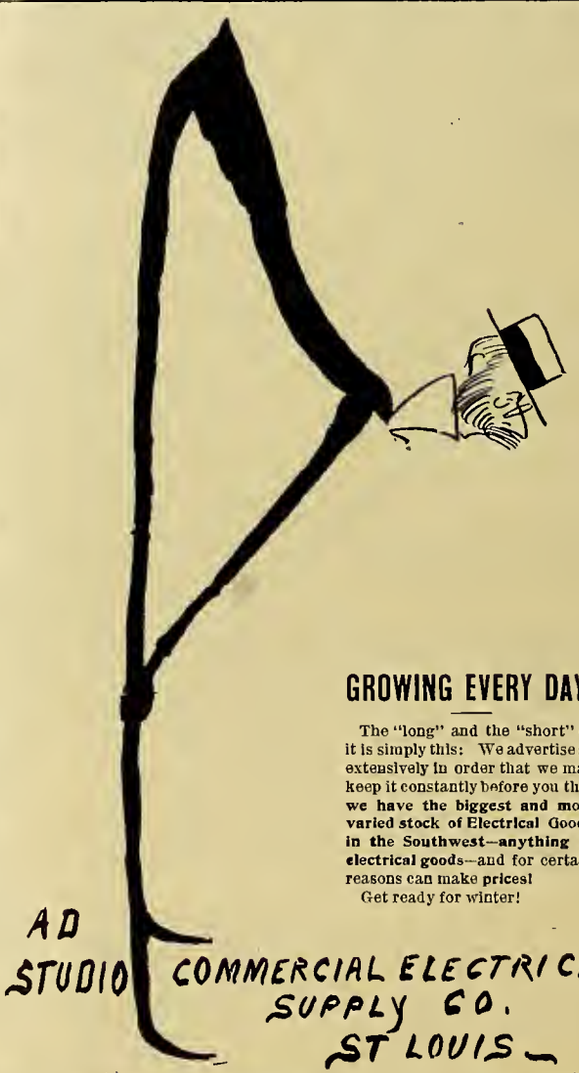
Yours truly, FOREE BAIN.

Chicago, July 6, 1897.

Write for detailed description.

STUDEBAKER BROS. MFG. CO.

SOUTH BEND, IND.



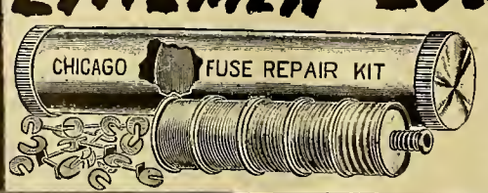
GROWING EVERY DAY.

The "long" and the "short" of it is simply this: We advertise so extensively in order that we may keep it constantly before you that **we have the biggest and most varied stock of Electrical Goods in the Southwest—anything in electrical goods**—and for certain reasons can make prices!

Get ready for winter!

AD STUDIO COMMERCIAL ELECTRICAL SUPPLY CO. ST LOUIS

LINEMEN LOOK!!!



This outfit contains FIVE sizes of FUSE WIRE each on a separate spool; also a good assortment of FUSE LINKS. The advantages of this outfit for the use of all LINE MEN and REPAIR MEN, will be seen at once, as all BREAKAGE of fuse links and ABRASION of fuse wire is prevented. A full assortment may be carried, weighing no more than one ordinary spool of fuse wire. We carry in stock fuse wire on spools to fit the above kit at ordinary prices of Fuse Wire. Sample Fuse Kit by mail complete with five sizes of fuse wire and an assortment of links, net, $1.00. Carried in stock by the trade.

154 LAKE ST. CHICAGO FUSE WIRE AND MFG CO. CHICAGO

HERE'S A LIST FOR PARTICULAR AND PROGRESSIVE BUYERS.

THERE MUST BE SOMETHING HERE THAT YOU NEED.

Okonite Wire,
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Helios Arc Lamps (100 and 150 hour, direct and alternating),
Sawyer-Man Incandescent Lamps,
Wagner Transformers,
Banner Weather-proof Wire,
Candee Line Wire,
Railway Supplies,
Queen-Wirt Instruments (Portable and Switchboard),
Scheeffer Wattmeters,
Lundell Power Motors,
Lundell Fan Motors,
Station Switches—
Anything and Everything Electrical.

Check off the articles you need and let us make you quotations.

OKONITE
IT NEVER DISAPPOINTS

Central Electric Company,

(1887-1897.)

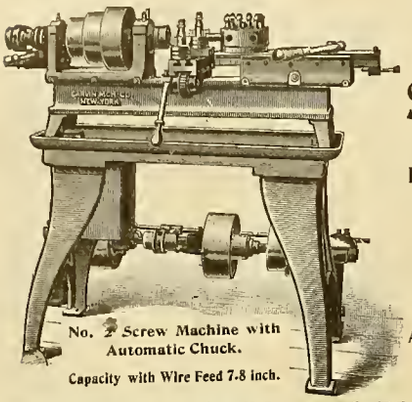
Geo. A. McKinlock, Prest.
Charles E. Brown, Secy.
S. R. Frazier, Treas.

173-175 Adams Street, Chicago.

The GARVIN MACHINE CO.,

51 N. 7th Street, PHILADELPHIA.

SPRING AND VARICK STREETS, NEW YORK.



No. 2 Screw Machine with Automatic Chuck.

Capacity with Wire Feed 7-8 inch.

We build 6 sizes of

Screw Machines

RANGING IN CAPACITY

From 1-4 inch to 2 1-2 inches.

WITH OR WITHOUT

Wire Feed, Back Gears, Geared Friction Head, Automatic Feed and Chasing Bar,

As the Size and Style of Work Require

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MACHINERY and MACHINE TOOLS

OF ALL KINDS KEPT IN STOCK.

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Designed for all Forms of Service.

Send for circulars and price lists.

3-Wire 22-Light Meter. Case Open, Showing Mechanism.

The . . . American Electric Meter Co.,

Cor. 9th Street and Montgomery Ave.,

PHILADELPHIA, PA.

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Partridge Carbon Co.
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Brill Co., J. G.

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California Asphalt Co.
Commercial El Supply Co.
Electric Appliance Co.
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Mass. Chemical Co.
McLennan & Co., K.
Okonite Co.

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Armorite Interior Cond. Co.
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Commercial El. Supply Co.
Electric Appliance Co.
Muir & Son, Thos.

Construction & Repairs.
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Hodge, Walsh & Loring.
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McFell Electric Co.
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United Elec. Imp Co.
Wagner Elec. Mfg. Co.
Warren Electric Mfg. Co.

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Westinghouse Elec & Mfg Co.

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Simplex Electrical Co.
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Washburn & Moen Mfg. Co.

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Peru Elec. Mfg. Co.
Wagner Elec. Mfg. Co.
Westinghouse El. & Mfg.Co.

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Keystone Electric Co.
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Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

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Fuel Economizer Co.

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Globe Electric Heating Co.
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Zamel Arc Light Meter Co.

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McRae, A. L.
Pratt. Chas. A.

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Weston Electrical Inst. Co.

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Diamond State Fibre Co.
Kartavert Mfg. Co.

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Central Electric Co.

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Commercial El. Supply Co.

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Central Electric Co.

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Besly & Co., Chas. H.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
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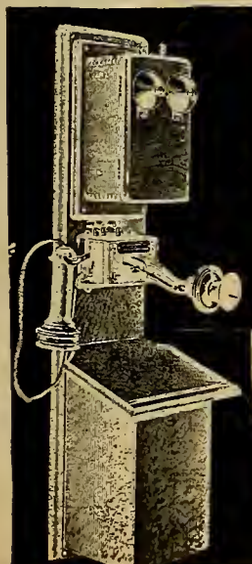

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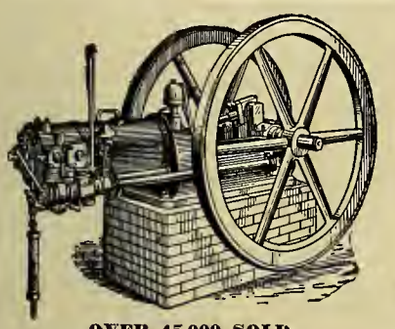

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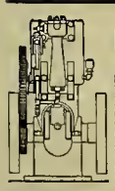

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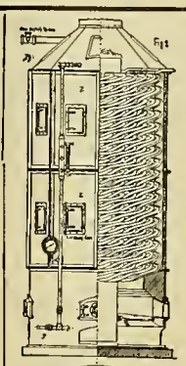

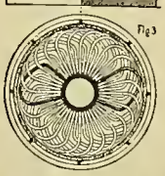

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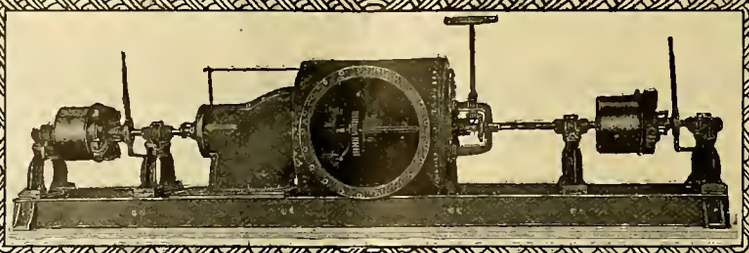

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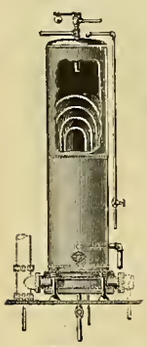

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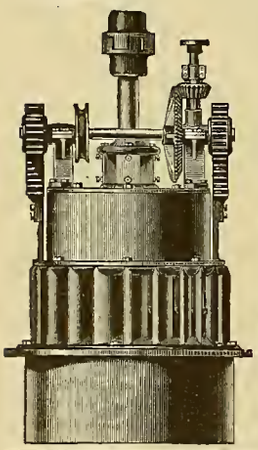

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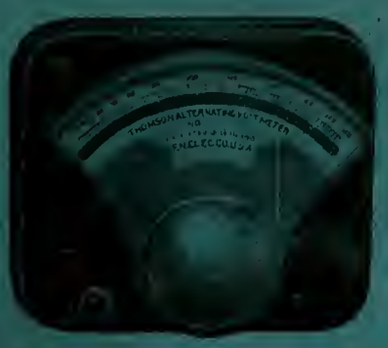

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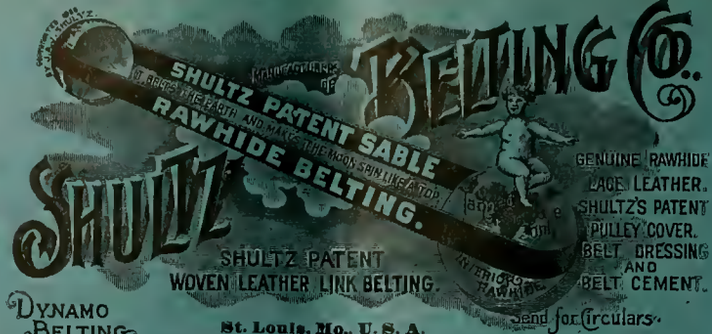

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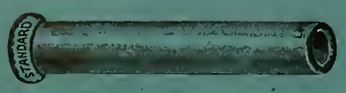

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SAVES 10% TO 20% IN FUEL.

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Complete Equipment for Central Stations and Isolated Plants.

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WARREN INDUCTION ALTERNATORS

Now let us enumerate a few of the good things that relate to them.

They have large steel shafts, which, with the extra long self-aligning and self-oiling bearings, permit running the rotor at the least possible clearance from the stationary parts, reducing the air gap to the merest fraction. They are not cheap machines to build, because the finest material and best work is insisted upon, and that is not cheap. THEY ARE CHEAP TO BUY because the expenditure stops with the purchase price. There are no repairs, no attendance.

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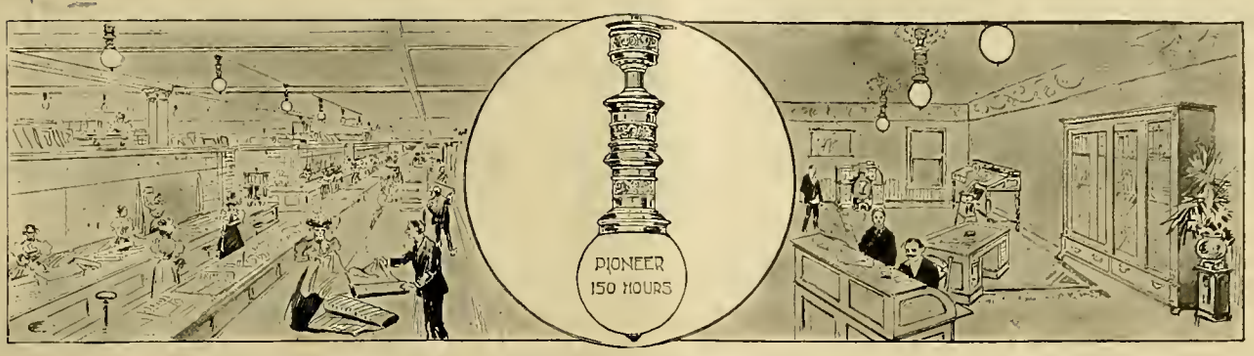

Salesman! How do you like the effect of our new Arc lamp?
Lady Shopper! It is excellent to match colors by, and burns with remarkable steadiness.

Employer! Well! How are you satisfied with the Pioneer Lamps?
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THE Pioneer Enclosed Arc Lamp has attained such perfection that it is being used in Stores, Offices and Factories and for interior illumination generally.

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SAFE! SIMPLE! ECONOMICAL!

Burns from 100 to 150 hours with one pair of Carbons.

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Makers of the PIONEER ENCLOSED ARC LAMP.

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LAMPS Efficient, Long-Lived and Guaranteed Satisfactory.

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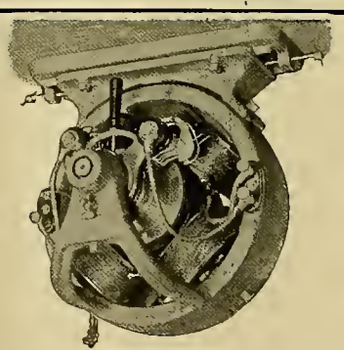

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15 to 1,000 Lights.

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Patented Adjustable Dynamos and Motors for Floor, Wall or Ceiling.

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CLEVELAND, OHIO.

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HARDTMUTH CORED CARBONS for Direct and Alternating Current ARC LAMPS.

HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

AMERICAN CARBON CO.'S Plain and Coated CARBONS FOR SERIES ARC LIGHTING.

GENERAL WESTERN AGENTS.

HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

Chicago Edison Co.,

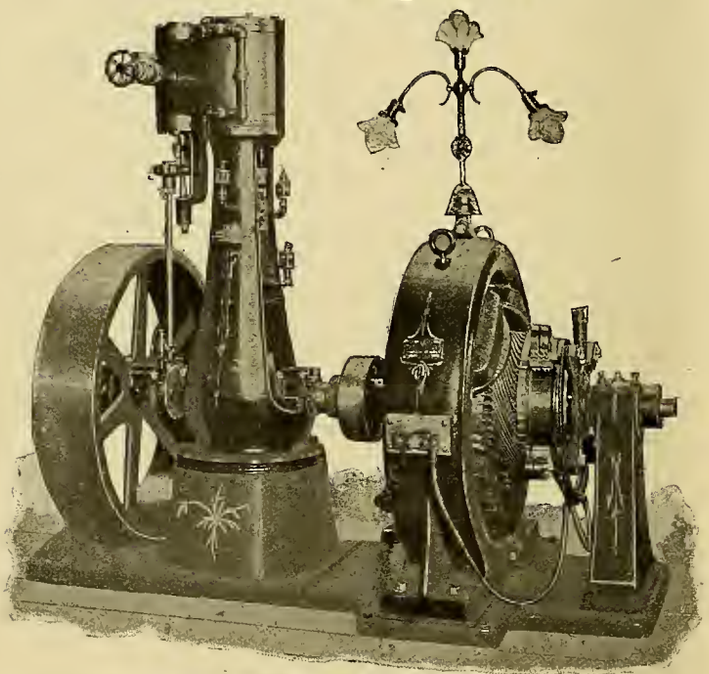
DEALERS IN ELECTRIC LIGHTING SUPPLIES,

139 Adams Street, CHICAGO.

YOUR TIME HAS COME

TO ECONOMIZE.

Independent Lighting Plants of Medium Size, or Plants of any Size for Manufactories, Hotels and Large Stores.



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CINCINNATI, OHIO.

THE . . .

Storey Motors.

Iron-clad. Completely Closed In. Dust and Moisture Proof. No External Magnetism.

Specially Adapted for Direct Connection to Machinery.

Special Direct Current Motors for All Classes of Work.

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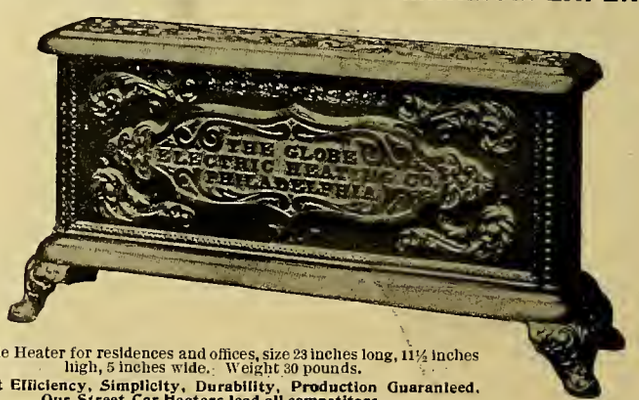
BRANCH FACTORY: Hamilton, Canada.

Cable address, Storey, Philadelphia. A B C Code used.

ELECTRIC HEATERS AVAILABLE TO ALL. MINIMUM EXPENSE.



Portable Heater for residences and offices, size 23 inches long, 11¼ inches high, 5 inches wide. Weight 30 pounds.

Highest Efficiency, Simplicity, Durability, Production Guaranteed. Our Street Car Heaters lead all competitors.

Send for new illustrated circular.

Heating coils renewed like incandescent lamps. Constructed for any voltage. Work on direct or alternating current. Consumes 6. 8 amperes on 110 volt current, 1. 5 on 500 volt current.

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TRANSFORMERS-WATTMETERS.

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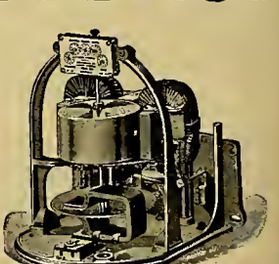
Double Primary Coils,
Double Secondary Coils,
Good Ventilation,
Light Weight,
High Efficiency,
Good Regulation,
Small Iron Loss.
Convenient to Install.

No Brushes,
No Commutator,
No Moving Wire,
Simplicity,
Durability,
Reliability,
Accuracy,
Even to a 6 c. p. Light.



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MANUFACTURERS,

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IT'S HARD TO GET AWAY FROM OKONITE.

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(1887-1897.)

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CHARLES E. BROWN, Secy.
S. R. FRAZIER, Treas.

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get ready for next month—
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"Low prices—big stock—
"Quick shipment to you.
"Some quote 'bed-rock' (?)
"We always do!"

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Ohio Storage Battery Co.
Willard El. & Battery Co.

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Electric Appliance Co.
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Main Belting Co.
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Central Electric Co.
Commercial El. Supply Co.
Crown Woven Wire Brush Co.
Holmes Fibre-Graphite Co.
Partridge Carbon Co.

Burglar Alarms.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Huebel & Manger.
Partrick & Carter Co.

Cables (See Insulated Wires.)
Cables, Electric (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Brixey W. R.
Central Electric Co.
Commercial El. Supply Co.
Eastern Electric Cable Co.
General Electric Co.
Moore, Alfred F.
New York Ins. Wire Co
Reliable Elec. Supply Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

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Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
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Partridge Carbon Co.
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Central Electric Co.
California Asphalt Co.
Commercial El. Supply Co.
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Mass. Chemical Co.
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Okonite Co.
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Conduit and Conduits.
Armorite Interior Cond. Co.
Central Electric Co.
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Roth Bros. & Co.
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United Elec. Imp Co.
Wagner Elec. Mfg. Co.
Warren Electric Mfg. Co.

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Ahlm-Edwards El. Co.
Arnold El. Pr. Station Co.
Bain, Foree.
Card Electric Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Keystone Electric Co.
McRae, A. L.
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Peoples Electric Co.
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Okonite Co., The.
Phillips Insulated Wire Co.
Reliable Elec. Supply Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

Cordage.
Central Electric Co.
Samson Cordage Wks.

Correspondence Schools.
Int. Correspond. Schools.

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Commercial El. Supply Co.
Edison Lamp Dept.

Cross-Arms, Pins and Brackets.
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Central Mfg. Co
Commercial El. Supply Co.
Electric Appliance Co.
Farr Tel. & Cons. Sup. Co.
Point Marion Mfg. Co.
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Cutter El. & Mfg. Co.
Eddy Elec. Mfg. Co.
Electric Appliance Co.
Emerson El. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Elec. Co.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Paiste Co., H. T.
Peoples Electric Co.
Peru Elec Mfg Co.
Reliable Elec. Supply Co.
Wagner Elec. Mfg. Co.
Westinghouse El. & Mfg. Co.

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Card Electric Co.
Central Electric Co.
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Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Evans Electric Co.
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Keystone Electric Co.
Muir & Son, Thos.
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Zamel Arc Light Meter Co.

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General Electric Co.
Westinghouse El. & Mfg. Co.

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McRae, A. L.
Pratt, Chas. A.

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Commercial El. Supply Co.
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Electric Appliance Co.
Emerson El. Mfg. Co.
General Electric Co.
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Keystone El. Instrument Co.
Paiste Co., H. T.
Queen & Co.
Reliable Elec. Supply Co.
Wagner Elec. Mfg. Co.
Weston Electrical Inst. Co.

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Automatic Cir. Breaker Co.
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Central Electric Co.
Commercial El. Supply Co.
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Paiste Co., H. T.
Peru Elec. Mfg Co.
Reliable Elec. Supply Co.
Splitdorf, C. F.
Thordarson, C. H.
Vought, M. I.

Electro-Plating Mach'y.
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Evans Electric Co.
General Electric Co.
Roth Bros. & Co.

Engines, Gas.
Foos Gas Engine Co.
Otto Gas Engine Wks.
Prouty Co., The.
Van Horne, Burger & Co.

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American Engine Co.
Ball Engine Co.

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Emerson El. Mfg. Co.
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Roth Bros. & Co.
Wagner Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

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Kartavert Mfg. Co.

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Partrick & Carter Co.
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Lombard Water Wheel Gv. Co.

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Holmes Fibre-Graphite Co.

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Queen & Co.
Splitdorf, C. F.

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Central Electric Co.
Chicago Edison Co.
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Diamond State Fibre Co.
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Emerson El. Mfg. Co.
Empire China Works.
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Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
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Okonite Co., The.
Paiste Co., H. T.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Phillips Insulated Wire Co.
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Simplex Electrical Co.
Standard Underground C. Co.
Wagner Elec. Mfg. Co.

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American Electrical Works.
Brixey, W. R.
Central Electric Co.
Chicago Edison Co.
Chicago Ins. Wire Co.
Commercial El. Supply Co.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
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Faries Mfg. Co.
Vought, M. I.

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Lamps, Incandescent.
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Chicago Edison Co.
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Electric Appliance Co.
General Electric Co.
Westinghouse El. & Mfg. Co.

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(See Insulated Wires.)

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Garvin Machine Co., The.
Stilwell-Bierce Smith-Vaile.

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Central Electric Co.
Commercial El. Supply Co.
Munsell & Co., Eugene.

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Belknap Motor Co.
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Central Electric Co.
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Eddy Elec. Mfg. Co.
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Ft. Wayne Elec. Corporation.
General Electric Co.
Keystone Electric Co.
Muir & Son, Thos.
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Peoples Electric Co.
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Triumph Electric Co.
United Elec. Imp. Co.
Wagner Elec. Mfg. Co.
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Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co
Williams, J. P.

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Garlock Packing Co.
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Baker & Co.

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McNaugton Co., J. C.
National Tube Works Co.
Perrizo & Sons.
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Belknap Motor Co.

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Chicago Edison Co.
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Thordarson, C. H.

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Central Electric Co.
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Muir & Son, Thos.
Westinghouse El. & Mfg. Co

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Cornman Co.
Electrical Exchange, The.
Elliott, W. H. Elec. Co.
Wood, Chas. N.

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Muir & Son, Thos.

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Central Electric Co.
Electric Appliance Co.
Partrick & Carter Co.

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Electric Appliance Co.
Moore, Alfred F.
New York Insulated Wire Co
Okonite Co., The.
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Mo. Tel. Mfg. Co.
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Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
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Brixey, W. R.
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Commercial El. Supply Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Standard Underground C Co
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Akron Ins. & Marble Co.

X Ray Outfits.
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Edison Lamp Dept.
Queen & Co.
Splitdorf, C. F.

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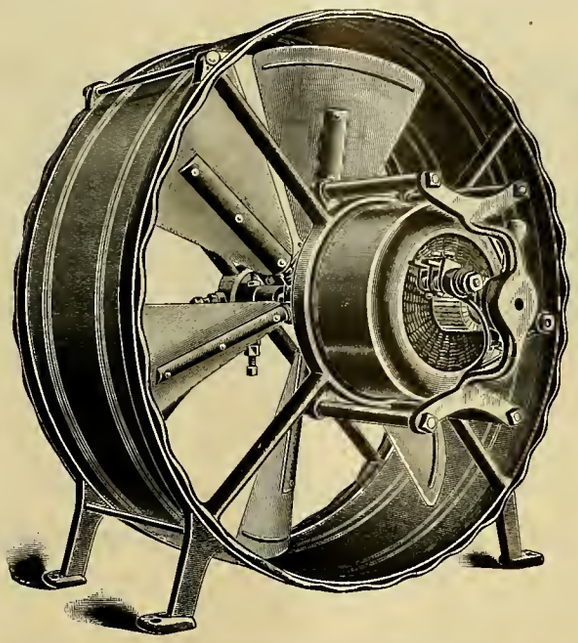
Our Exhaust Wheel Combinations

Are the most compact and efficient made.
Write for catalogue and prices.



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Also for Primary or Secondary Battery Circuits.

Highest Efficiency

Unbroken Magnetic Circuit, Self-Aligning Bronze Bearings. Finest Insulation Throughout. Four-Speed Regulator.

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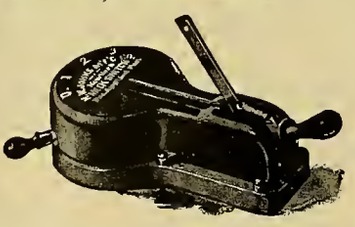
SIMPLE, DURABLE, EFFECTIVE, ECONOMICAL.

Heat evenly distributed full length of car. Three degrees of regulation with patented knife switch. No coils to short-circuit or break.



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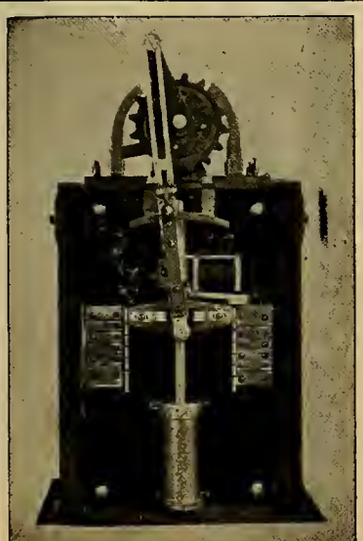

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MANUFACTURERS OF RHEOSTATS FOR ALL PURPOSES.

104 VOLTS. 6 AMPERES.

380 WATTS.

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ROOM 7, FIRST FLOOR.

City of Boston.

Office of Electrical Construction Division
of Public Buildings Department.

September 13 th 1897

Mr Stuart W. Wise

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After an extended test of your Puritan Lamp by this Div. We have found it satisfactory in every particular and up to the claims you have made. We tested Lamp on 104 Volt Circuit at 6 amperes and the wattage ranged from 340 to 380 which we consider exceptionally good. The test lasted 4 hours, and we are perfectly satisfied to use them whenever possible. Hoping you will have the success which your Lamp merits.

I am most Respt.

H Sleeth

Chief of Elec Const Div.

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PURITAN ELECTRIC CO.,

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FOR ENCLOSED LONG-BURNING ARC LAMPS.

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HIGHEST GRADE NUERNBERG CARBONS

UNEQUALLED IN QUALITY AND EFFICIENCY

ABSOLUTELY STEADY AND BRILLIANT LIGHT.

HUGO REISINGER 38 BEAVER ST. NEW YORK.

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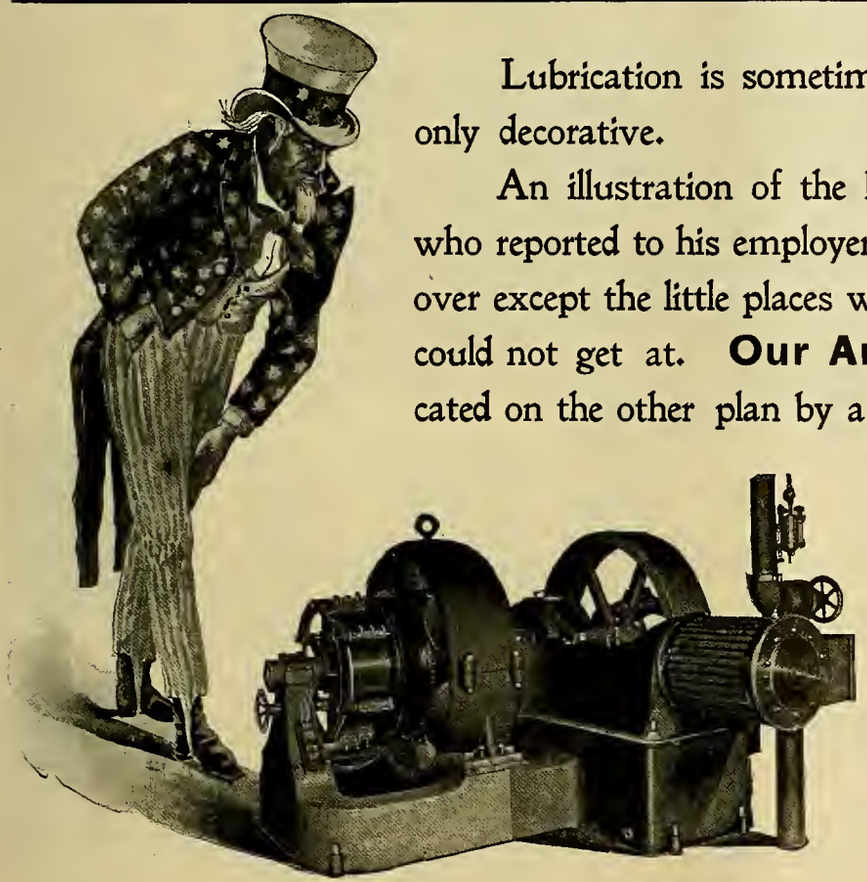

Lubrication is sometimes useful and effective, or it may be only decorative.

An illustration of the latter was given by the "hired man" who reported to his employer that he had "greased" the wagon all over except the little places where the wheels turn around, which he could not get at. **Our American-Ball Engines** are lubricated on the other plan by a constant stream of cleansed oil automatically poured on "the little places where the wheels turn around," and without any attention from the "hired man."

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AND SEVERAL OTHER STYLES,

ALL OF HIGHEST EXCELLENCE.

Pure Copper Switches and Switchboards.

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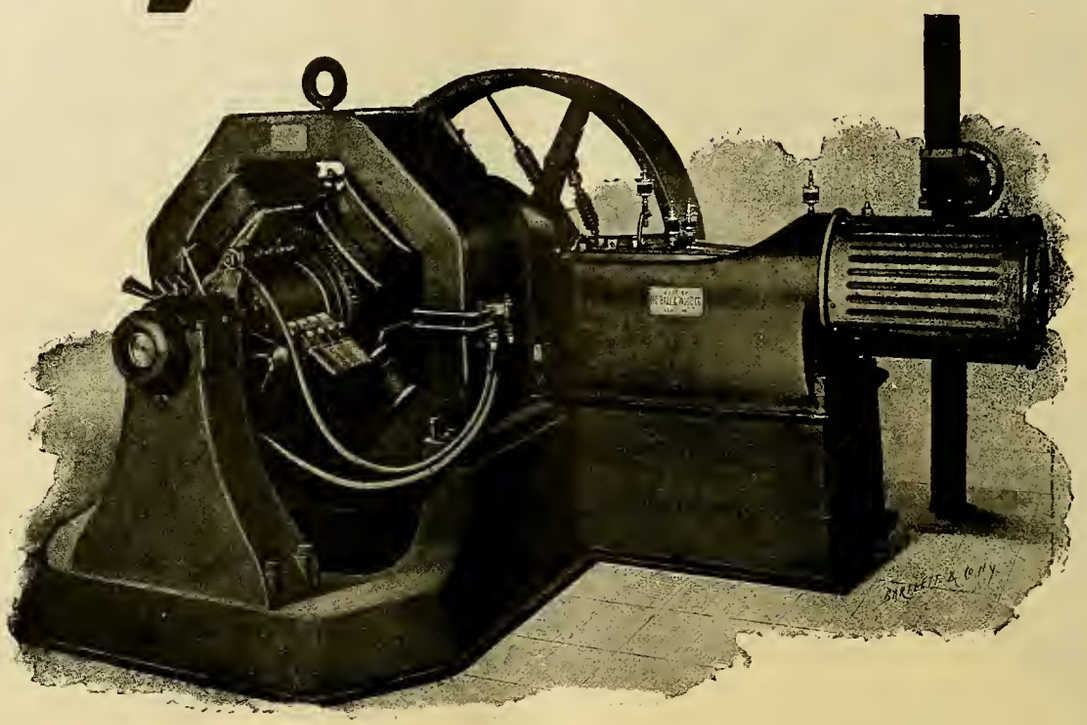

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We build all necessary apparatus for the transmission of Electrical Power through factory or other buildings.

All Our Apparatus Guaranteed as Represented.

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San Francisco, Cal., California Electrical Works, 409 Market St.
Elmira, S. N. Blake.
St. Louis Western Electrical Supply Co.
Kansas City, W. T. Osborn.
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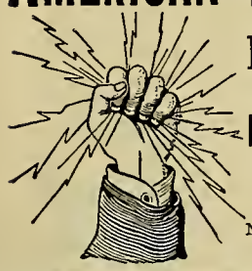
Western Office: 204 Dearborn St., Chicago, Wallace & Hine, Western Agents.

EUGENE F. PHILLIPS, Prest. F. N. PHILLIPS, Treas. W. H. SAWYER, Secy.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



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WATERVILLE, ME., Jan. 18, 1896.

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NON-INFRINGING.
PROTECTION GUARANTEED.
The Willard Electric & Battery Co.,
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FOR ALL OPEN CIRCUIT WORK.
Points of Superiority Over All Other Types.
In successful use for ten years. Standard high. Prices low. Send for descriptive circular and testimonials.
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The 4 Leading Electric Novelties.
We undersell all on Everything Electrical.

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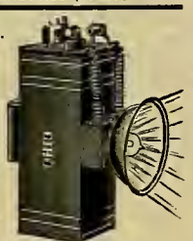
Dollar Motor.

$3 Necktie Light.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Send for Our Pamphlet on the Prevention of Boiler Incrustation.

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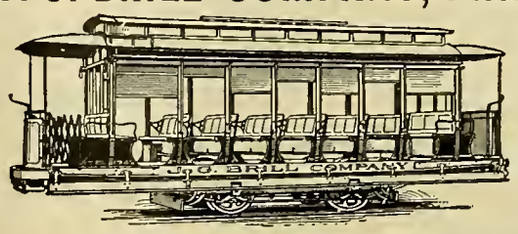

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WE CAN SUBSTANTIATE OUR CLAIMS.

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For Lighting and Plating.

20 light..... $ 40 00
50 light..... 75.00
100 light..... 125.00

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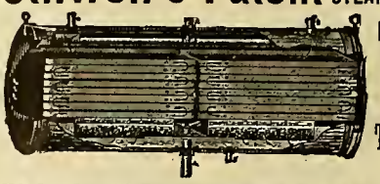

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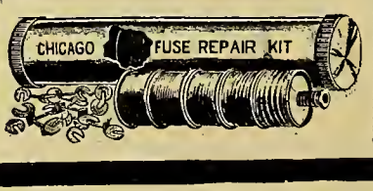

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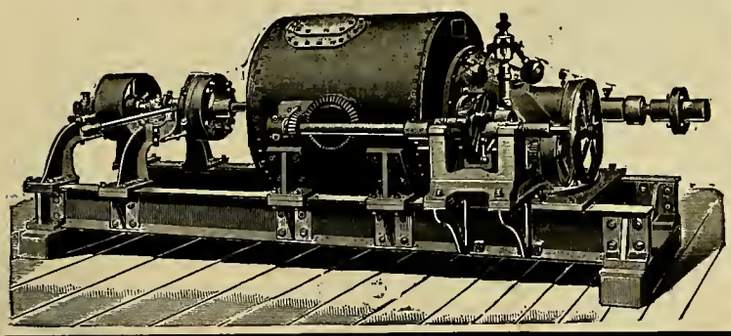

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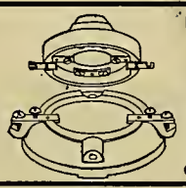

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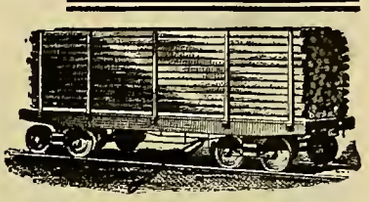

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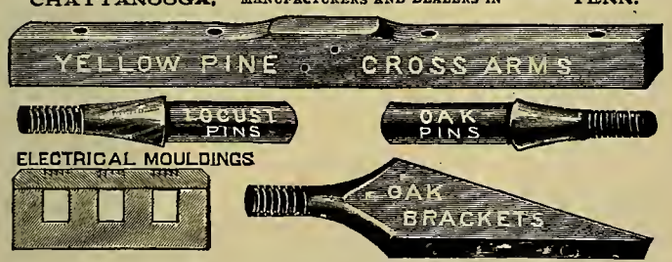

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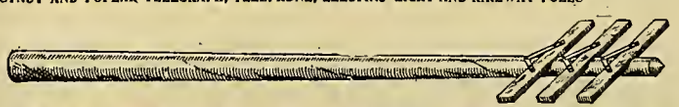

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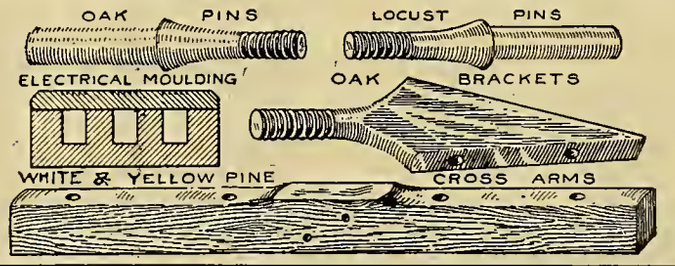

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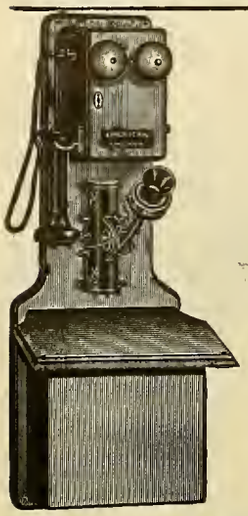

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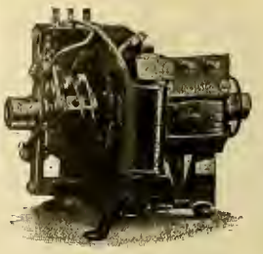

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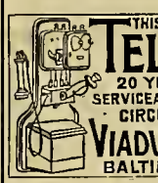

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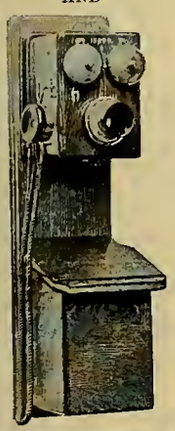

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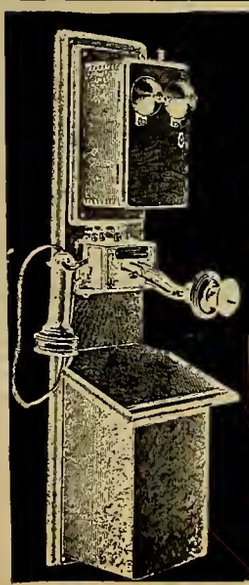

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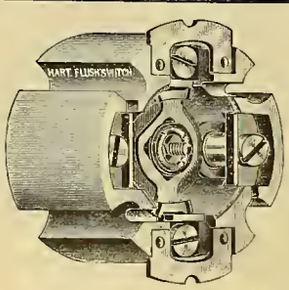

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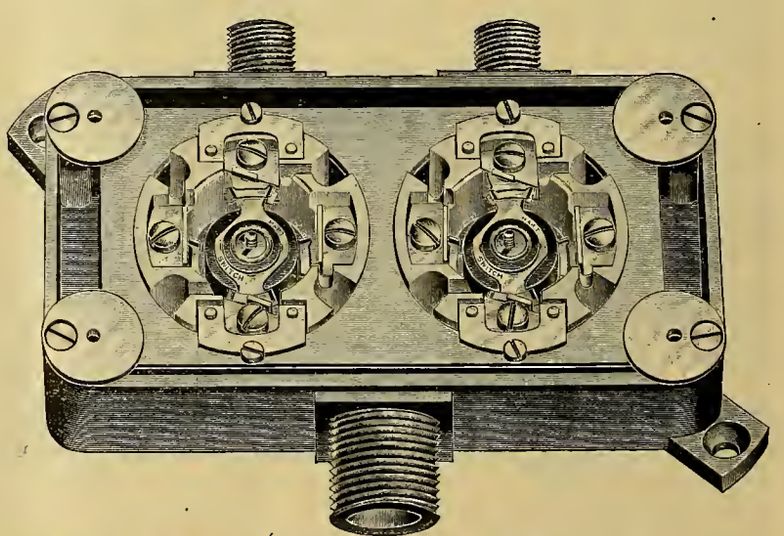

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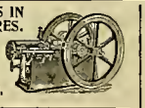

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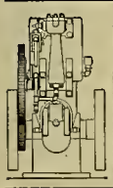

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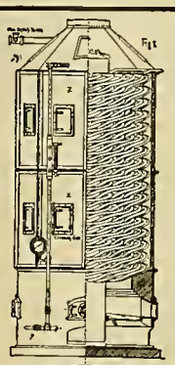

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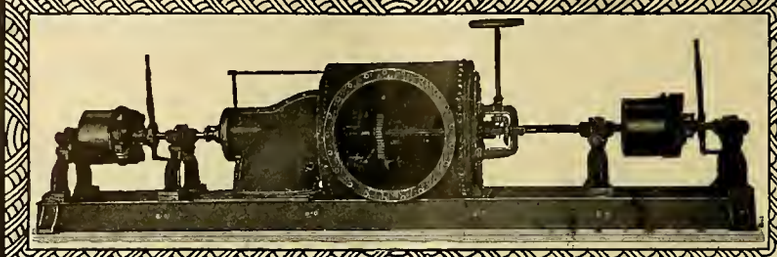

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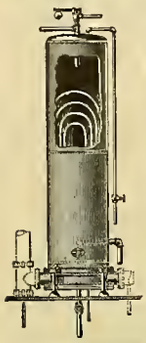

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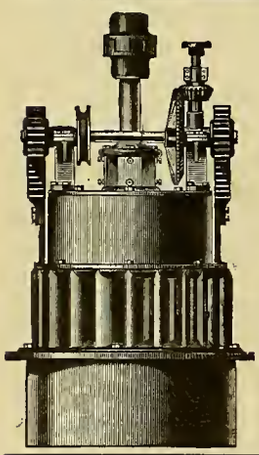

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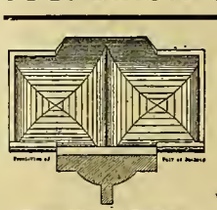

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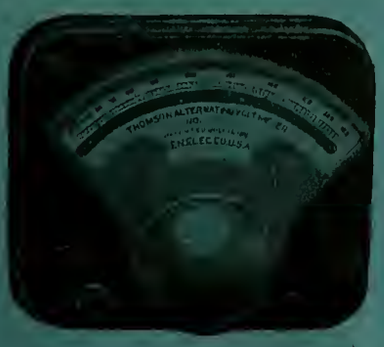

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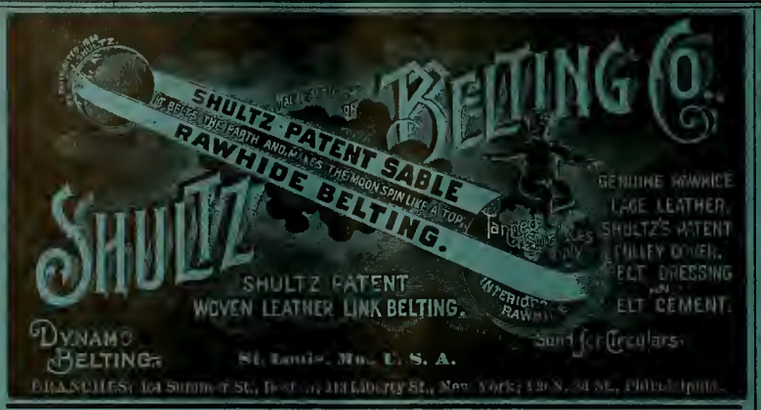

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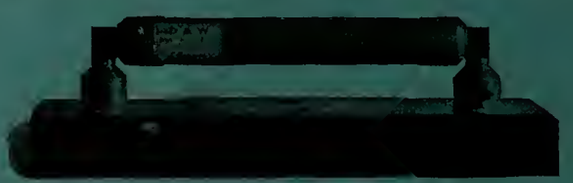

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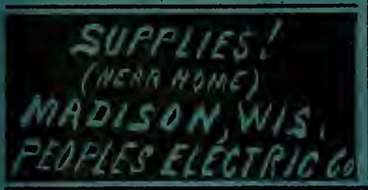

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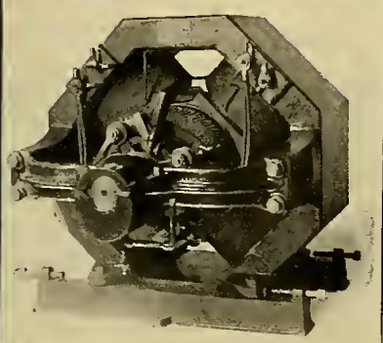

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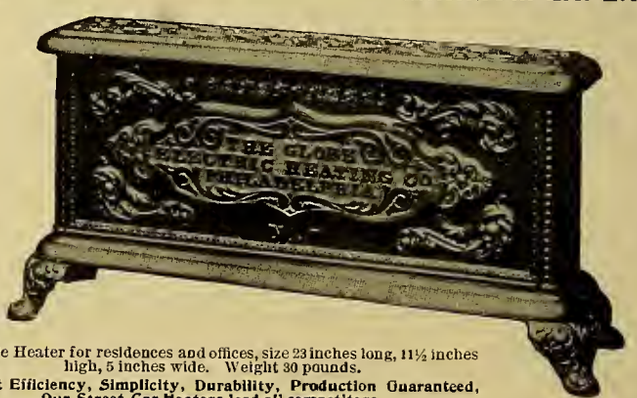

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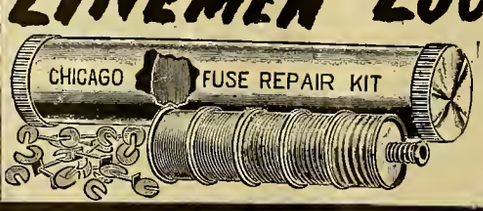

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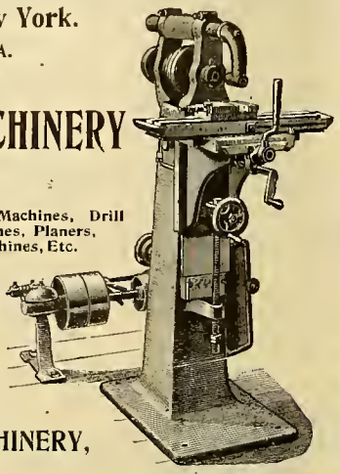

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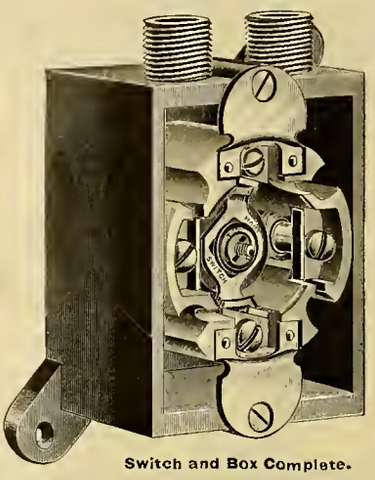

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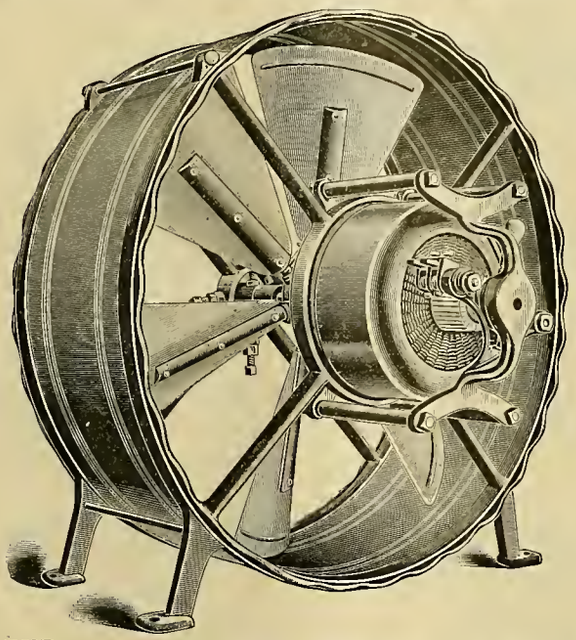

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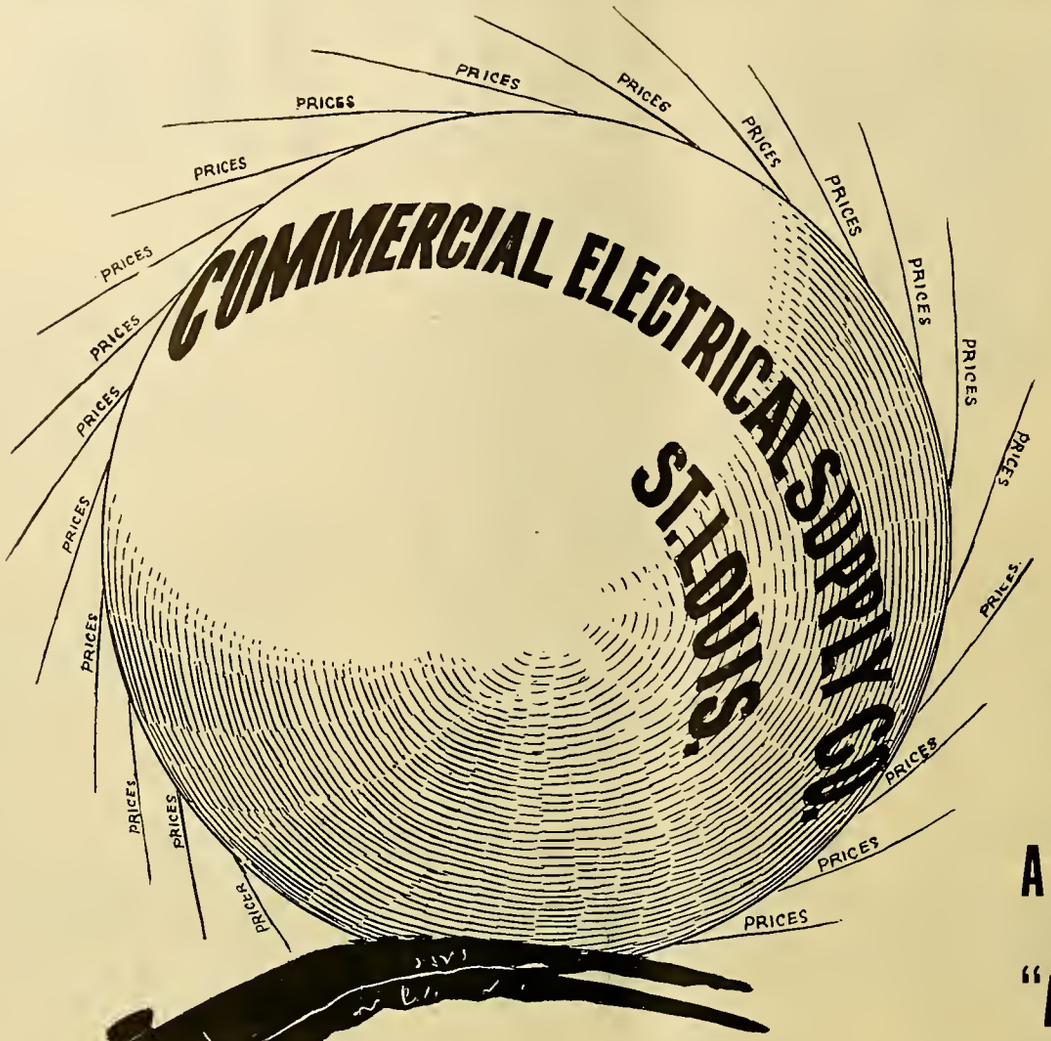

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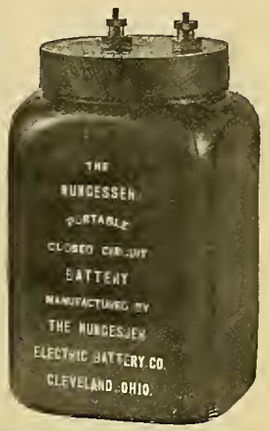

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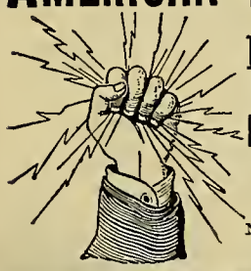

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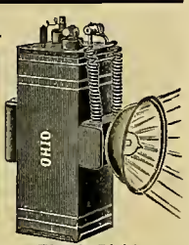

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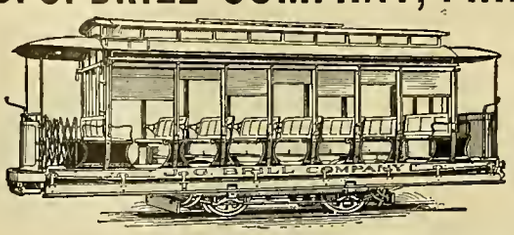

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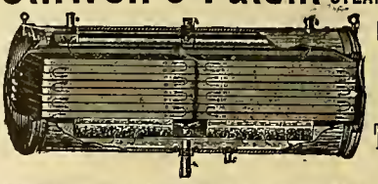

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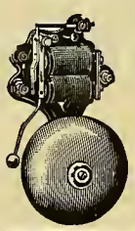

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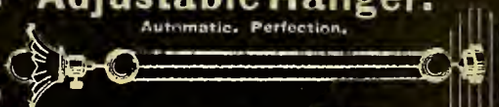

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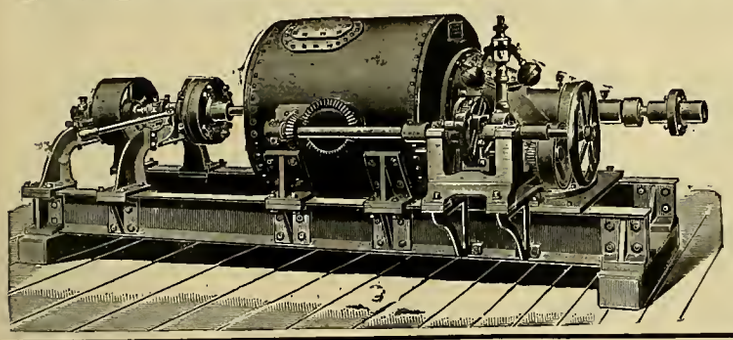

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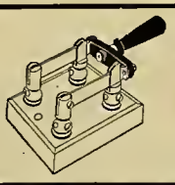

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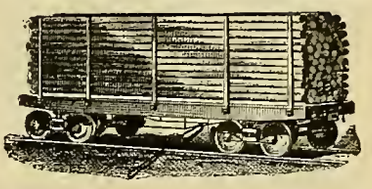

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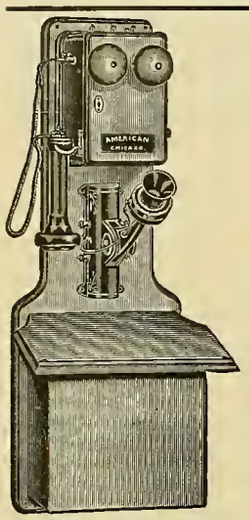

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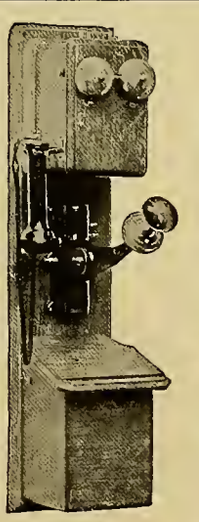

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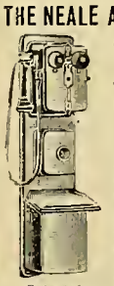

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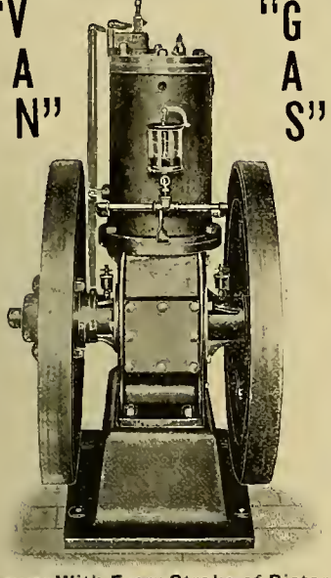

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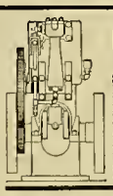

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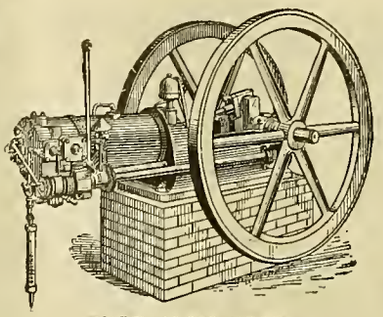

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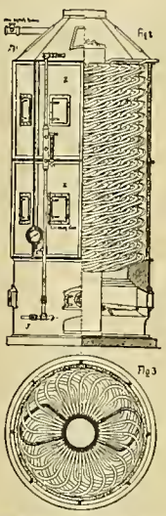

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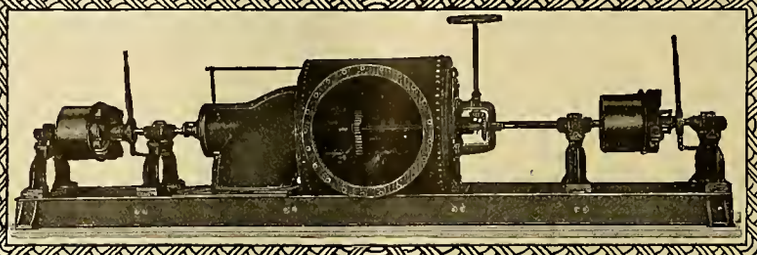

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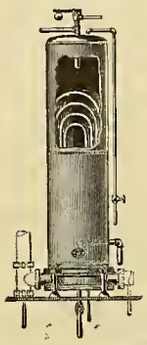

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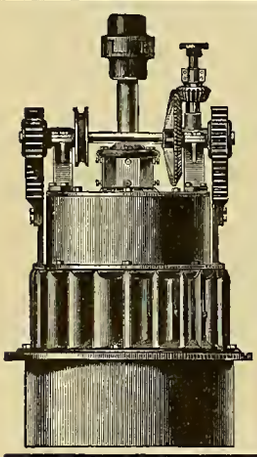

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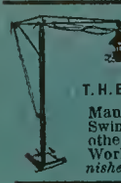

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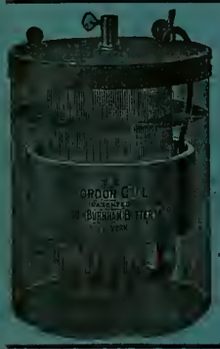

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Approved by the National Fire Underwriters' Association.

Western Electrician

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Vol. XXI. CHICAGO, OCTOBER 16, 1897. No. 16

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Also High-Grade Rubber Covered Wires and Cables.

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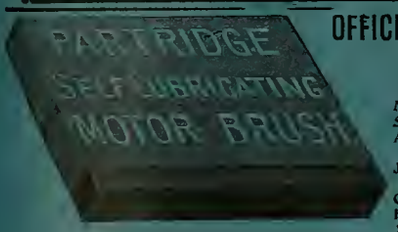

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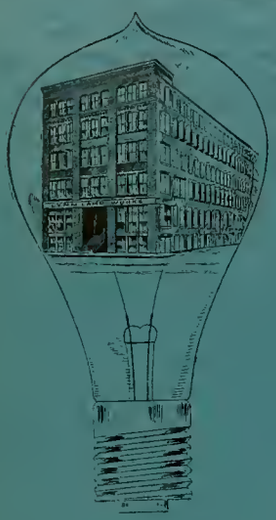

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Did you know that your burned out lamps are worth 3 cents each when sent us?

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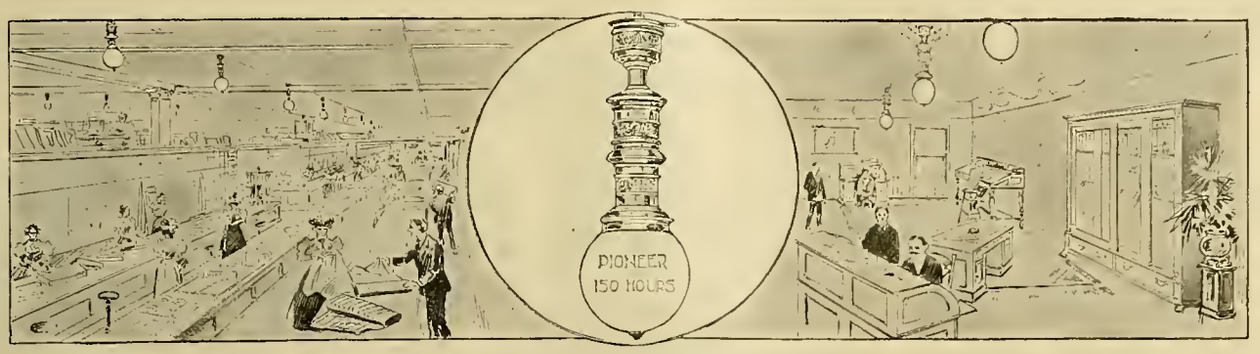

Salesman! How do you like the effect of our new Arc lamp?
Lady Shopper! It is excellent to match colors by, and burns with remarkable steadiness.

Employer! Well! How are you satisfied with the Pioneer Lamps?
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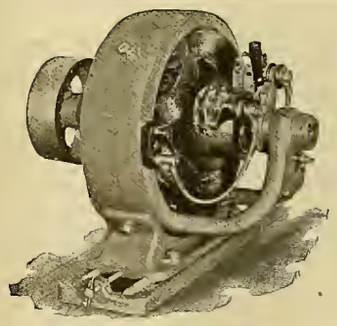

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Patented Adjustable Dynamos and Motors for Floor, Wall or Ceiling.

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CLEVELAND, OHIO.

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HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

AMERICAN CARBON CO.'S Plain and Coated CARBONS FOR SERIES ARC LIGHTING.

GENERAL WESTERN AGENTS.

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NON-INFRINGING. DURABLE. LIGHT.

The Ohio Storage Battery Company,

Office and Factory removed to
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A THOROUGH EDUCATION

In the theory of the Operation and Installation of Electric Light, Power and Railway Plants, including Mathematics, Mechanics and Mechanical Drawing for $25.

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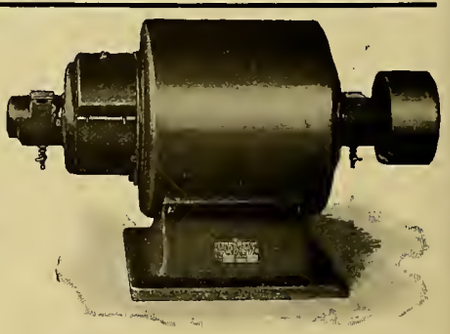
THE . . .

Storey Motors.



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Specially Adapted for Direct Connection to Machinery.

Special Direct Current Motors for All Classes of Work.

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BRANCH FACTORY: Hamilton, Canad

Cable address, Storey, Philadelphia. A B C Code used.

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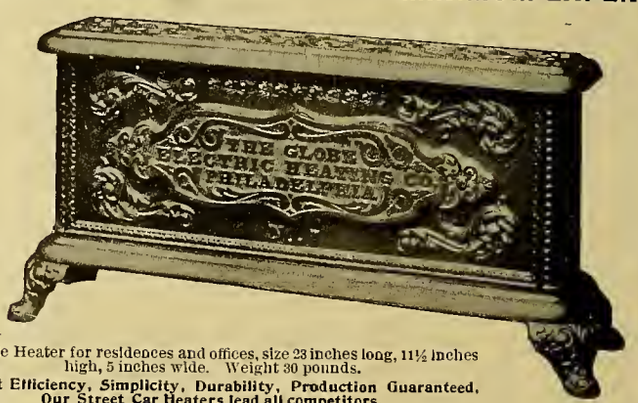

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(SCHEEFFER'S IMPROVED.)

Double Primary Coils,
Double Secondary Coils,
Good Ventilation,
Light Weight,
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Good Regulation,
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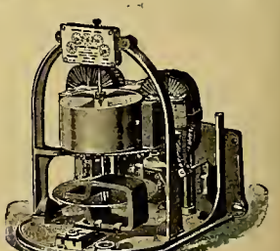
Convenient to Install.

No Brushes,
No Commutator,
No Moving Wire,
Simplicity,
Durability,
Reliability,
Accuracy,
Even to a 6 c. p. Light.



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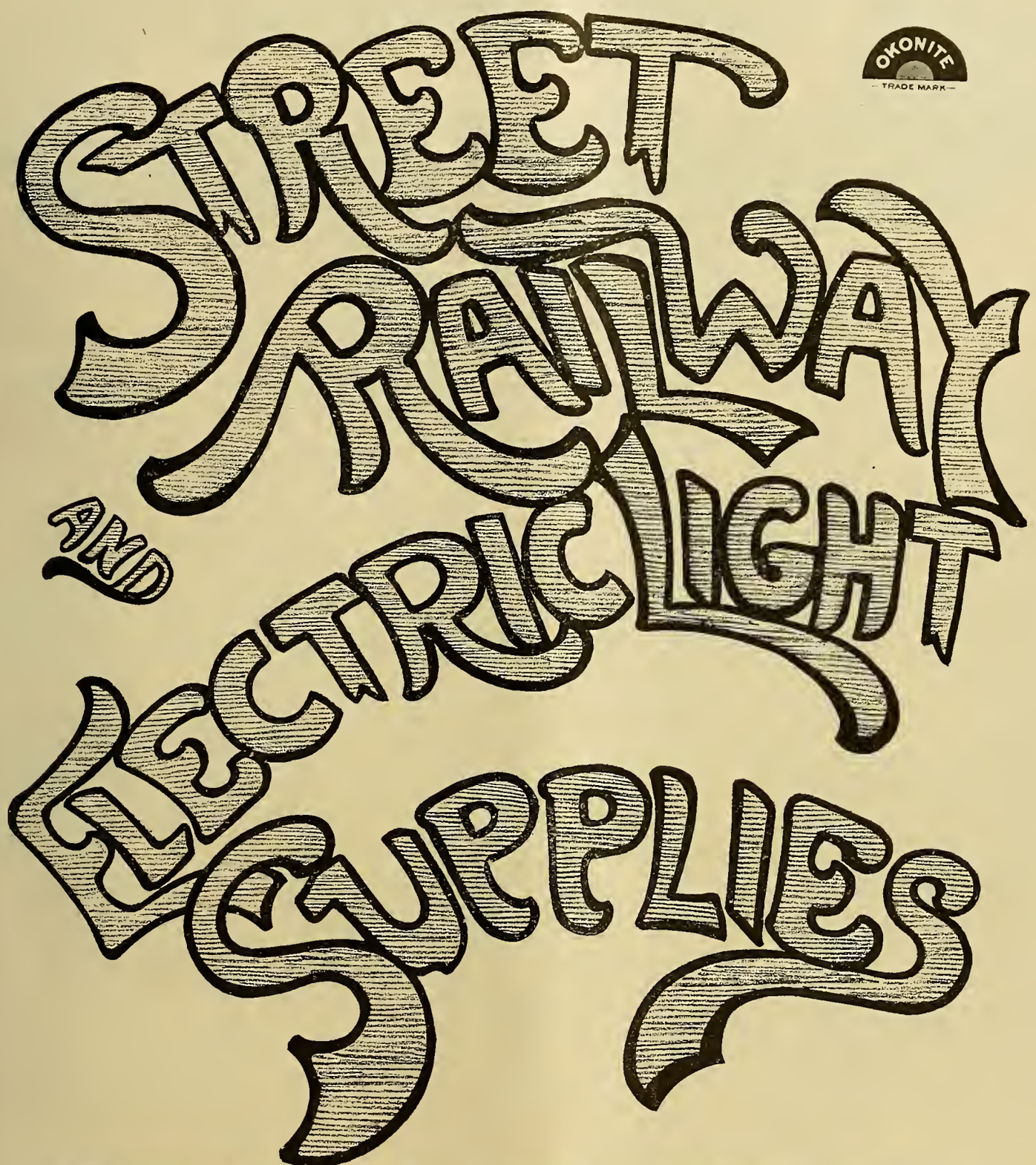
Factory: Peoria, Ill.



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Geo. A. McKinlock, President Charles E. Brown, Secretary S. R. Frazier, Treasurer

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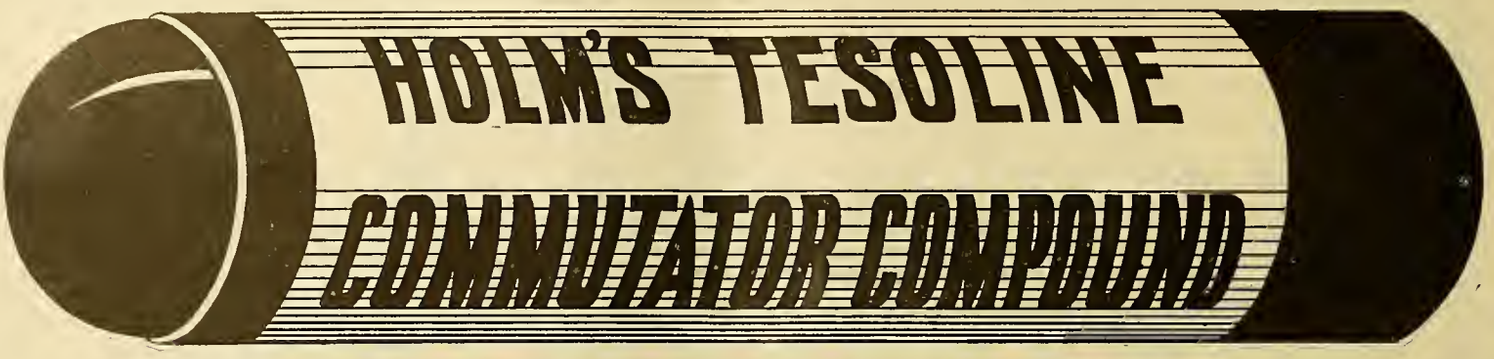

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Partrick & Carter Co.
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Chicago Edison Co.
Electrical Exchange, The.
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Wagner Elec. Mfg. Co.
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Bain, Foree.
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Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
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Triumph Electric Co.
United Elec. Imp. Co.
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Besly & Co., Chas. H.
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Mansfield Temp. Copper Co.
Mitchell Temp. Copper Co.

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Besly & Co., Chas H.
Brixey, W. R.
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Electric Appliance Co.
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Pratt, Chas. A.

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Peru Elec. Mfg. Co.
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Thordarson, C. H.
Vought, M. I.

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Roth Bros & Co.

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Paiste Co., H. T.
Peoples Electric Co.
Peru Elec. Mfg. Co.
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Electric Appliance Co.
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Faries Mfg. Co.
Vought, M. I.

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Electric Appliance Co.
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Besly & Co., Chas. H.
Garvin Machine Co., The.
Stilwell-Bierce Smith-Vaile.

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Commercial El. Supply Co.
Munsell & Co., Eugene.

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Westinghouse El. & Mfg. Co.

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Central Electric Co.
Commercial El. Supply Co.
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Eddy Elec. Mfg. Co.
Evans Electric Co.
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United Elec. Imp. Co.
Wagner Elec. Mfg. Co.
Walker Company.
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Warren Electric Mfg. Co.
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Wright, Wm.

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Electrical Exchange, The.
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Wright, Wm.

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Muir & Son, Thos.

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Queen & Co.
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Pelton Water Wheel Co.
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Brixey, W. R.
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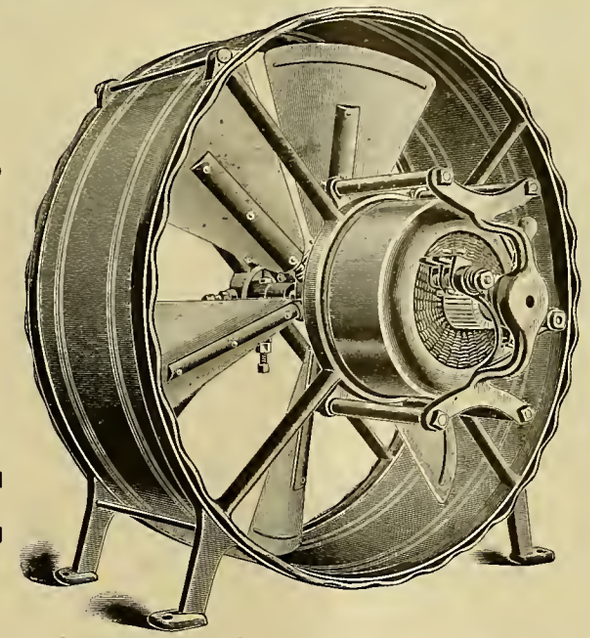

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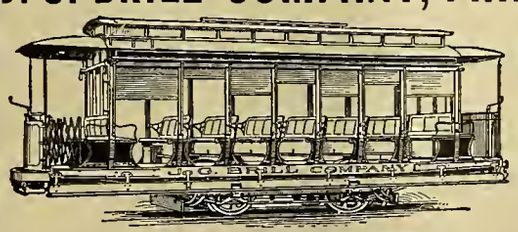

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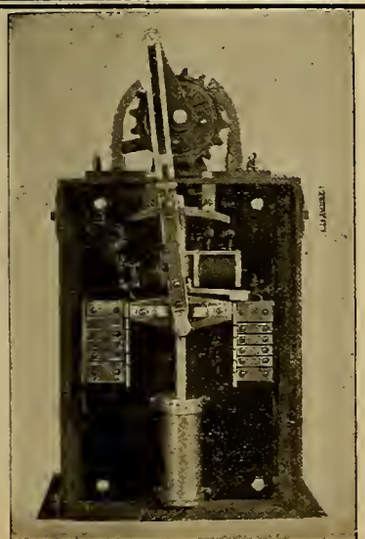

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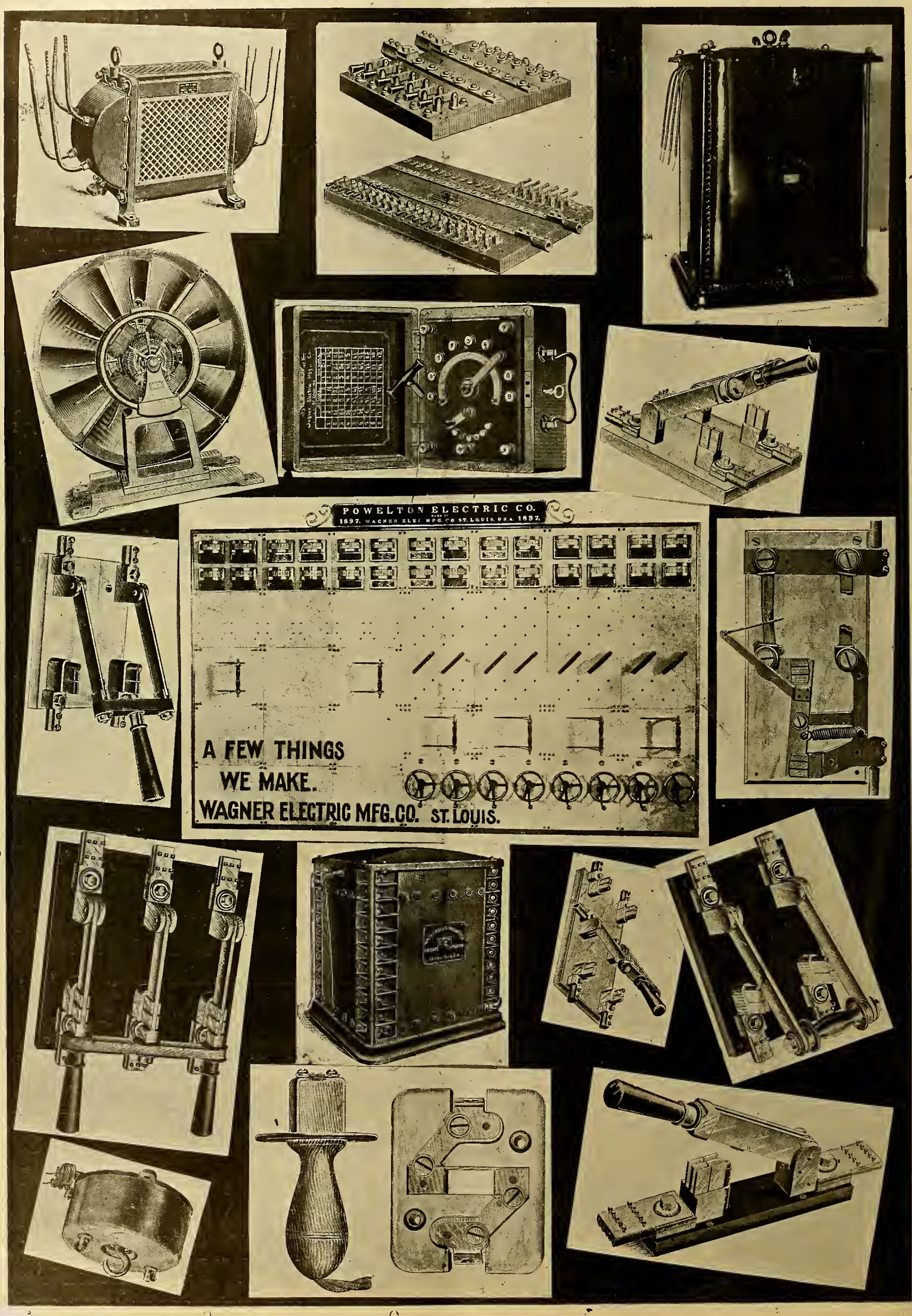
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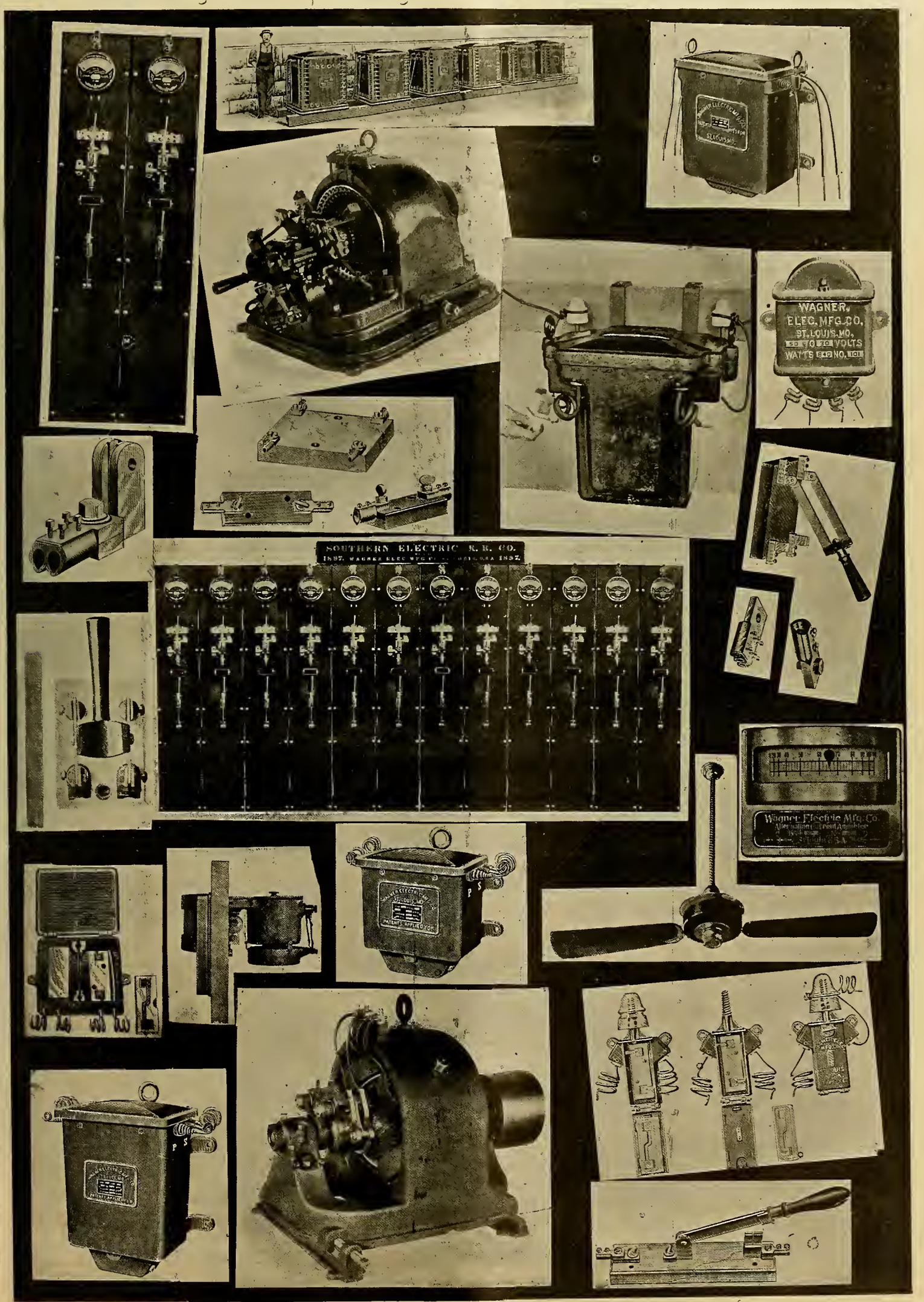
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High Grade Electrical Apparatus AND Street Railway Generators.

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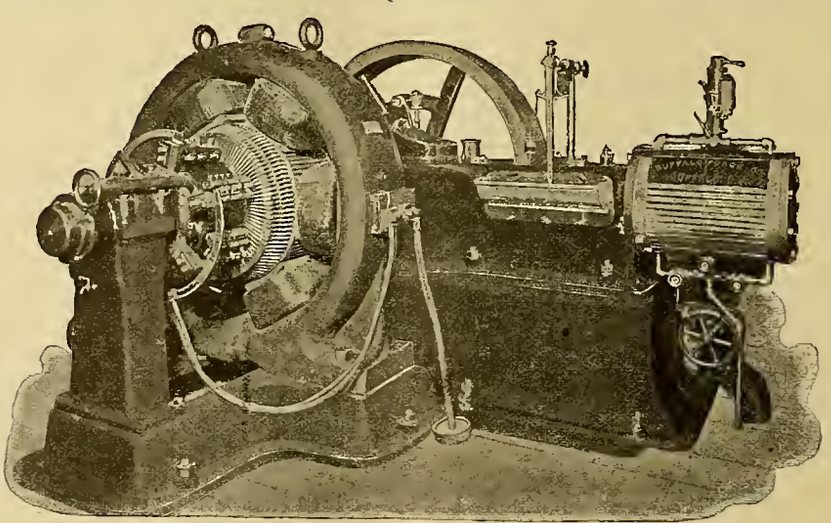

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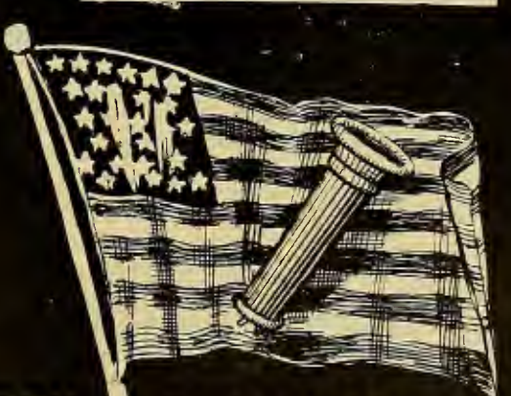

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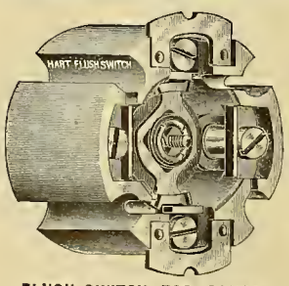
IN GANGS OF ANY NUMBER.

THE SWITCHES ARE INSERTED AND CONNECTED UP FROM THE FRONT.



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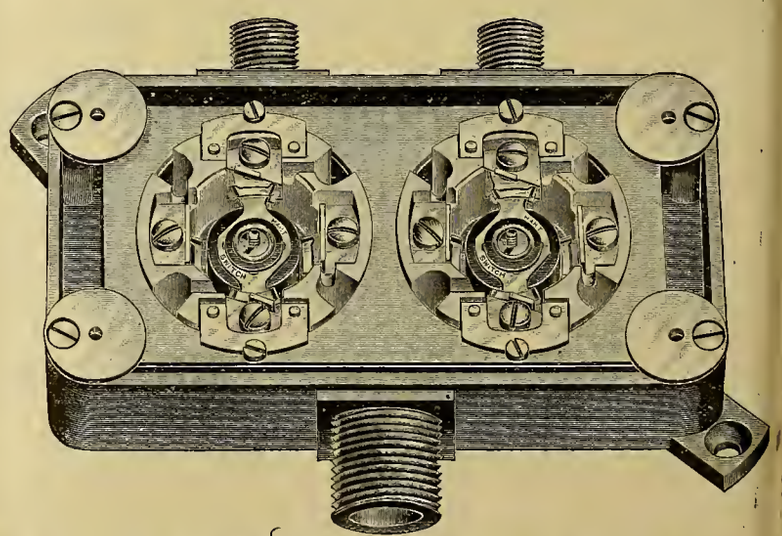

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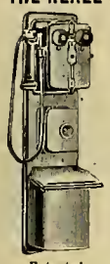

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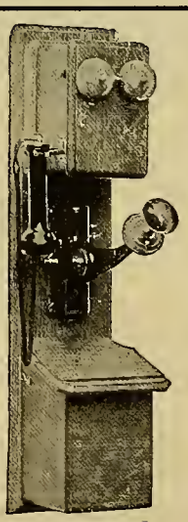

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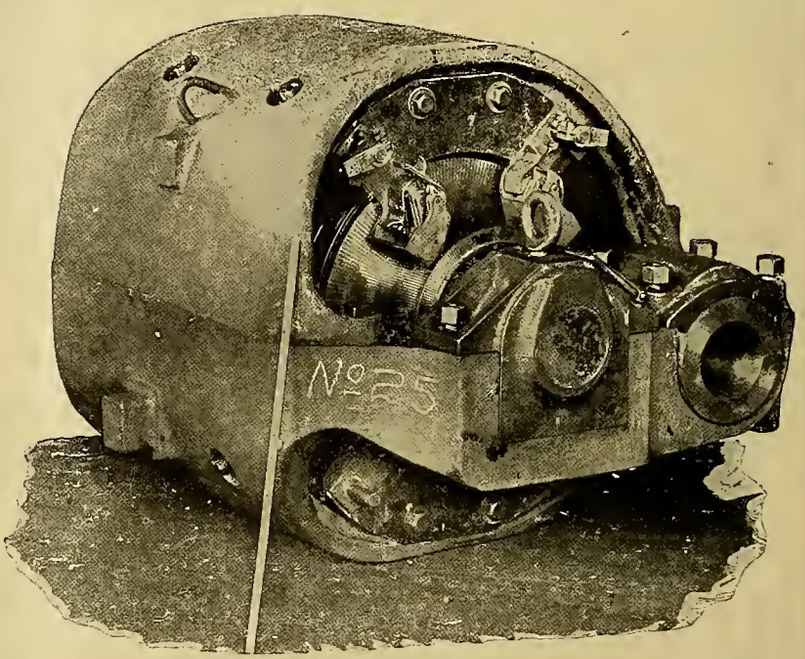

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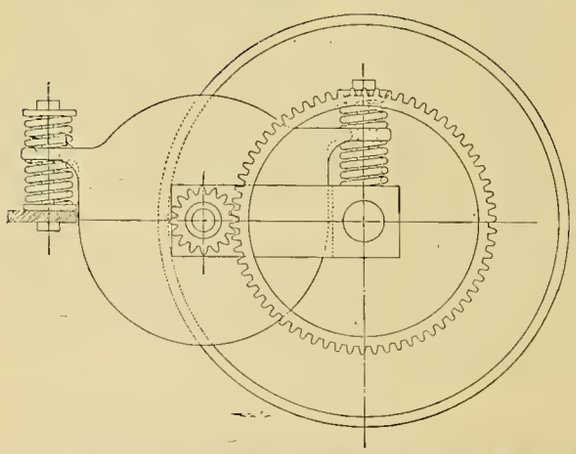

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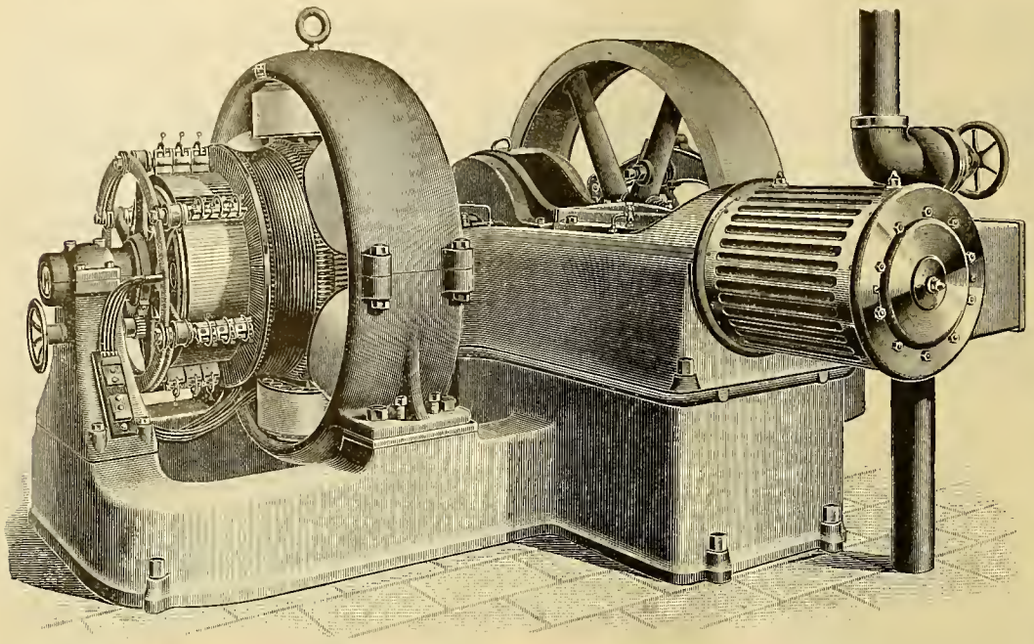

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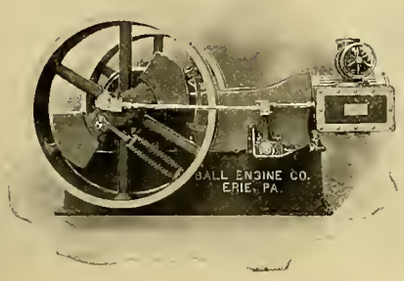

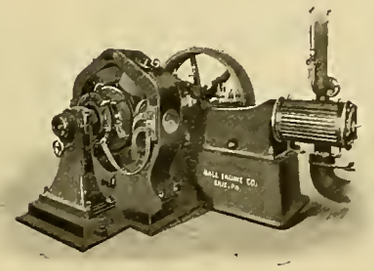

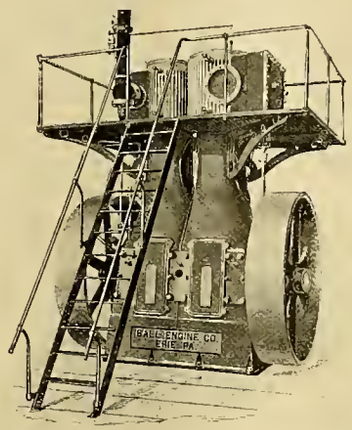

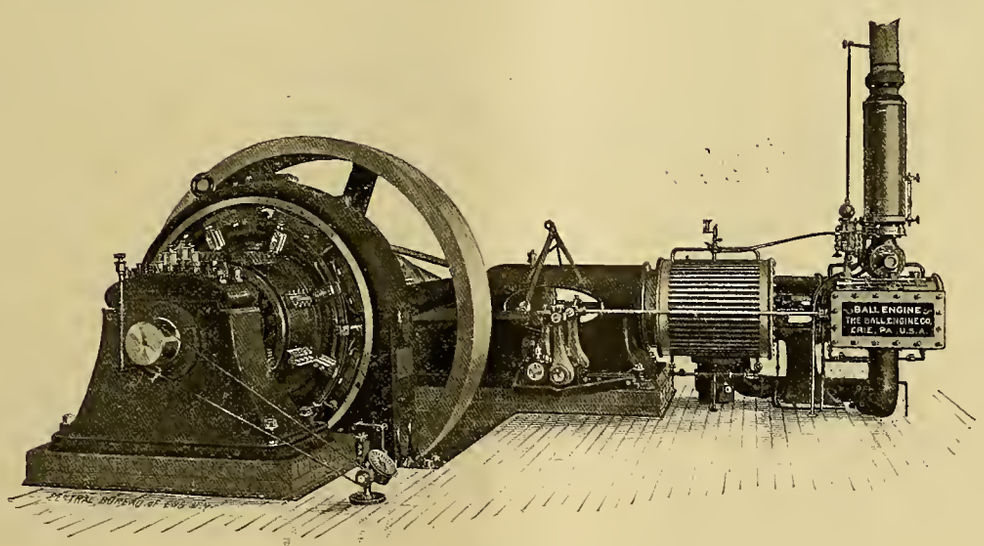

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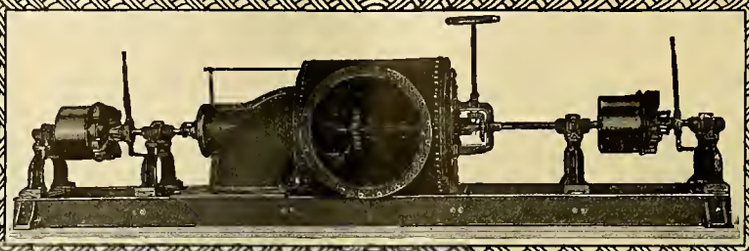

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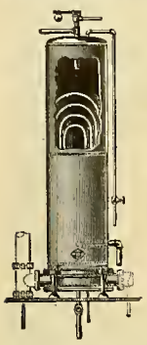

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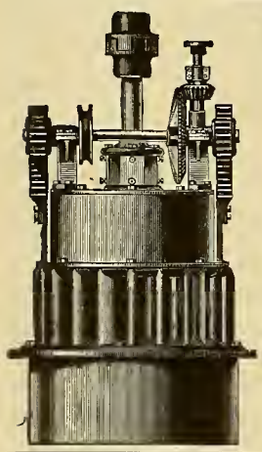

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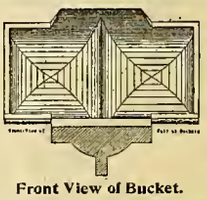
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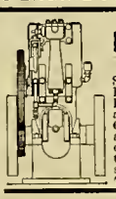

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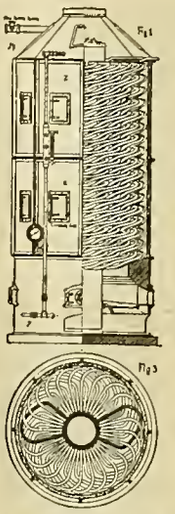

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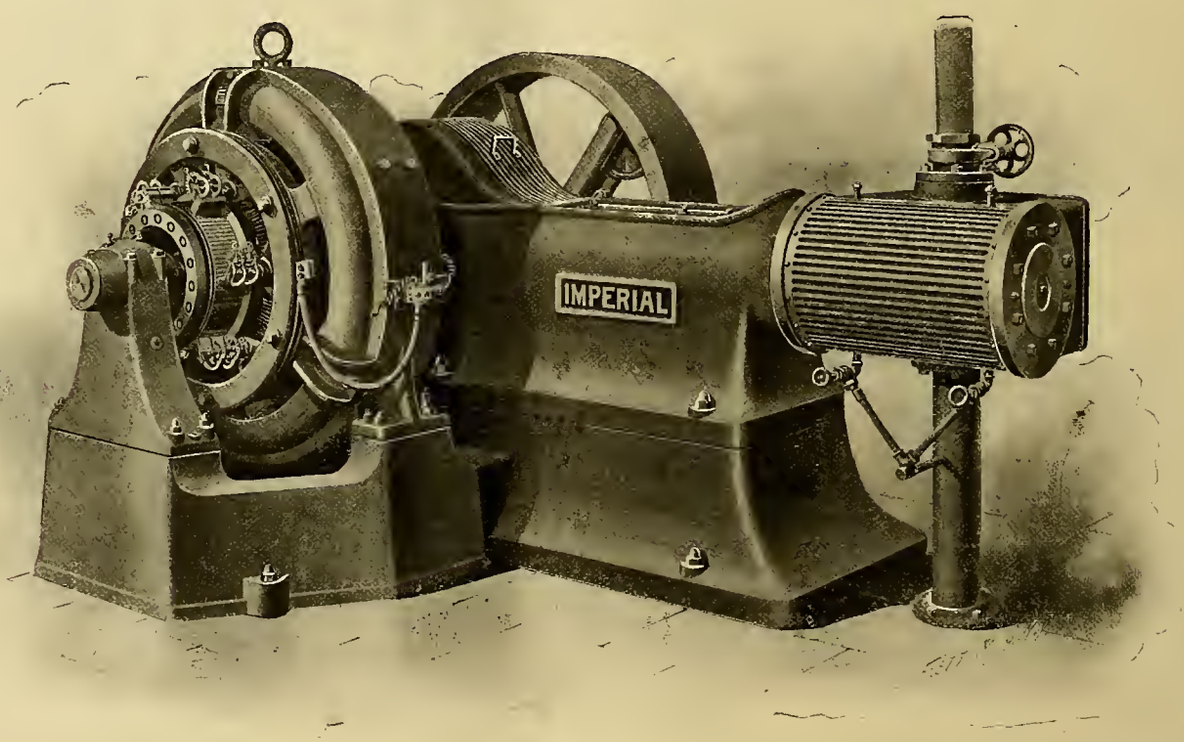

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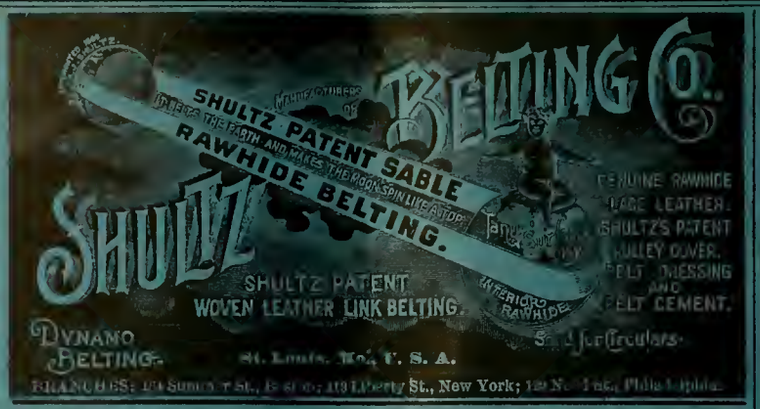

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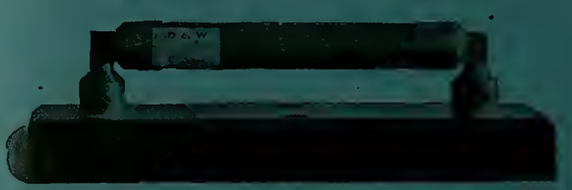

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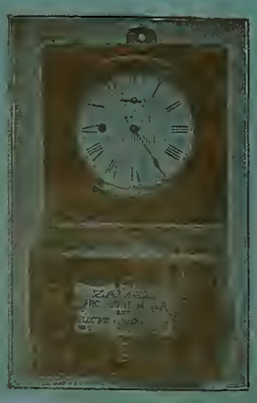

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Alcatraz Electrical Compound,

Manufactured by

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ELECTRICAL AND WIRE INSULATION, Insulating Connections, Dynamos and Motor Bases, Battery and Accumulator Shelving, Circuit and Switch-Boards.
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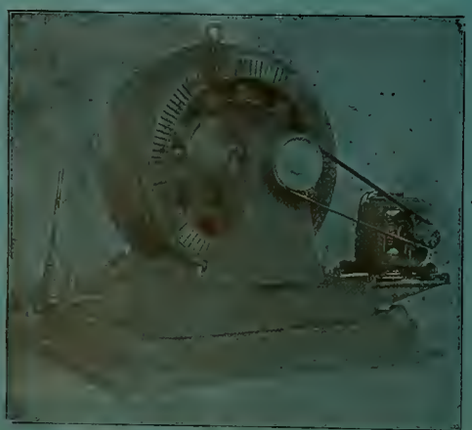

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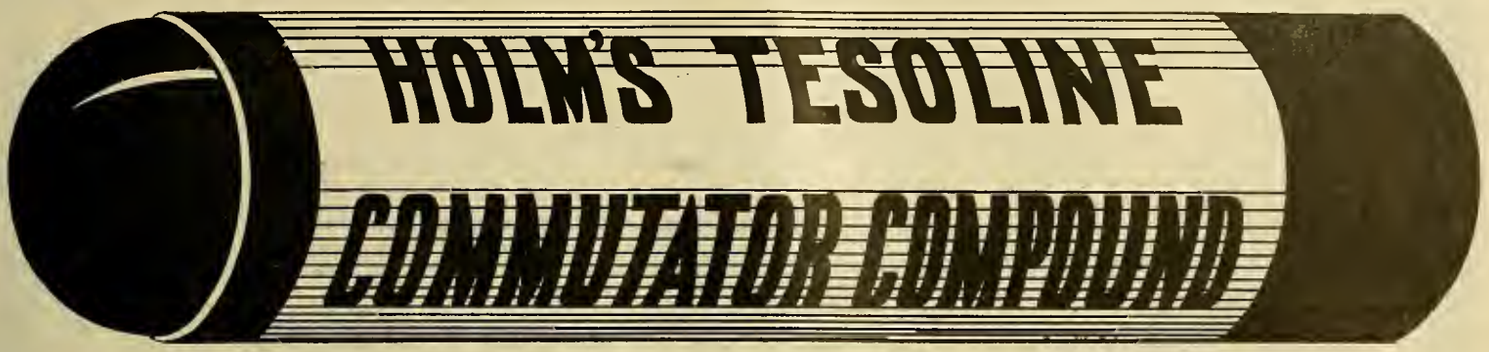

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QUALITY UNEQUALED.
FACTORY PRODUCTION TRIPLED.
INCANDESCENT LAMPS.
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Fans
Instruments.
Switchboards.
Transformers.
D. C. Motors
and Generators

TRANSFORMERS!
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HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

AMERICAN CARBON CO.'S Plain and Coated CARBONS FOR SERIES ARC LIGHTING.

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HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

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HIGH GRADE MULTIPOLAR & BIPOLAR DYNAMOS & MOTORS SLOW & MEDIUM SPEED

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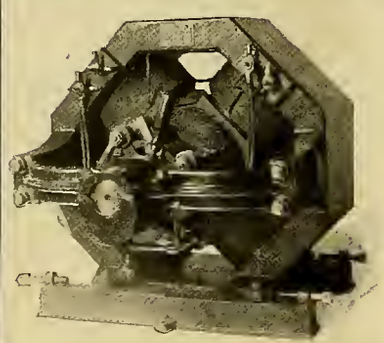

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PRICES GREATLY REDUCED.

WRITE YOUR JOBBER FOR REVISED FIGURES.

THE BRYANT ELECTRIC CO.,

BRIDGEPORT, CONN. CHICAGO, ILL.

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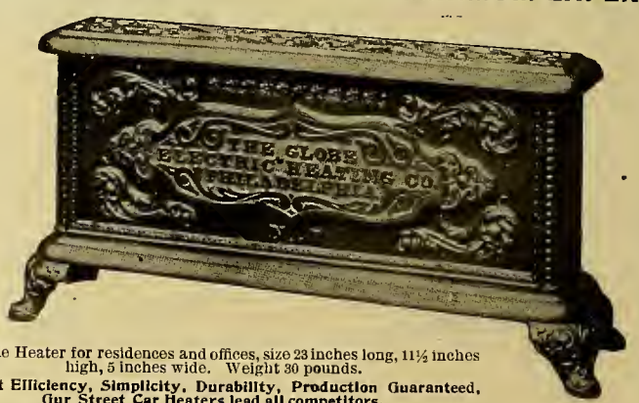
FORT WAYNE, IND.

Apparatus for

Arc, Direct Current and Alternating Incandescent Lighting and Power Transmission.

ELECTRIC HEATERS AVAILABLE TO ALL. MINIMUM EXPENSE.



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(SCHEEFFER'S IMPROVED.)

Double Primary Coils,
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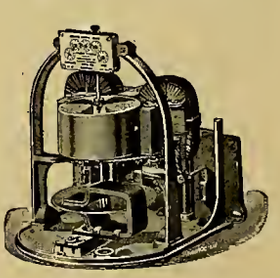
Good Ventilation,
Light Weight,
High Efficiency,
Good Regulation,
Small Iron Loss.
Convenient to Install.

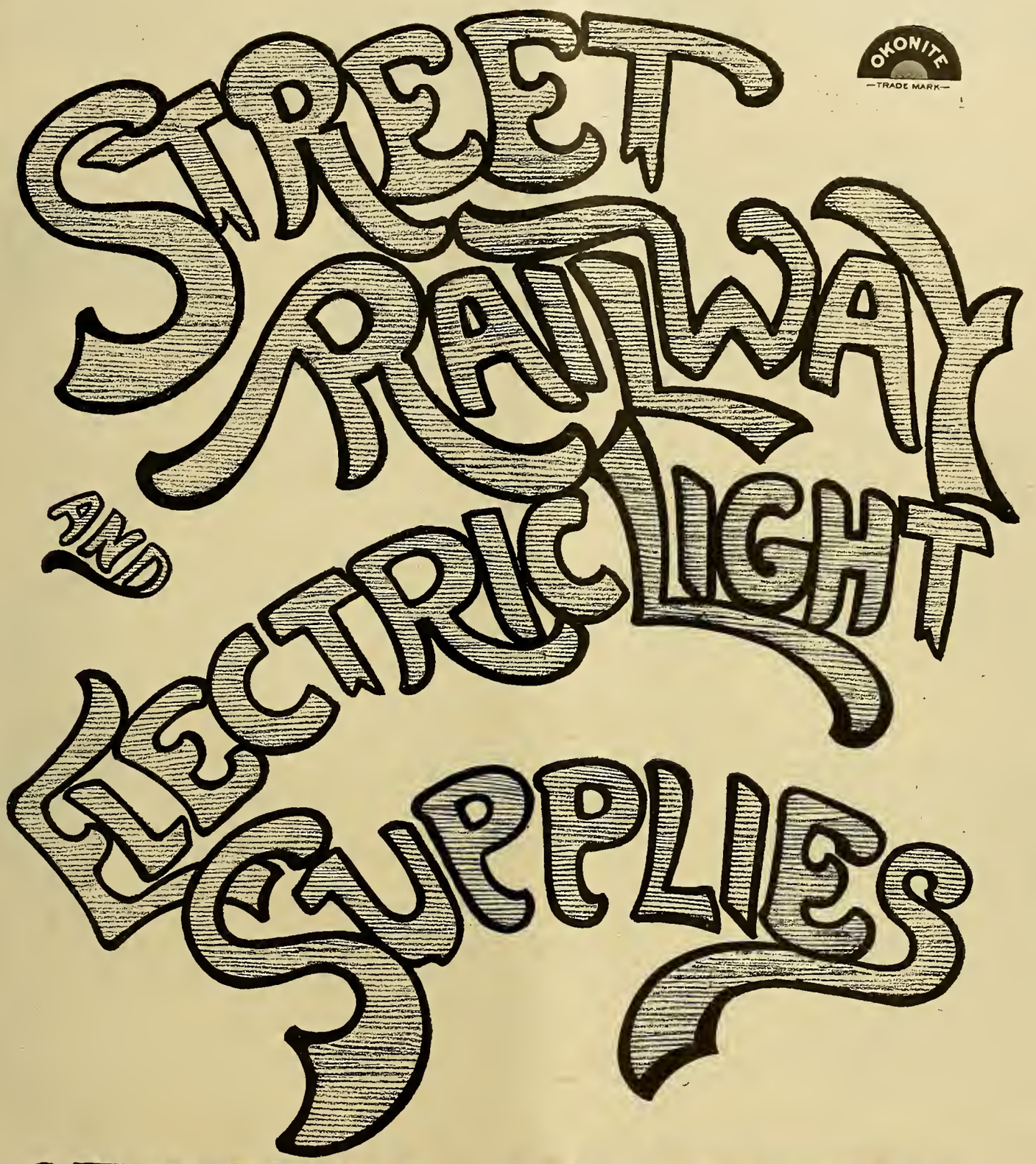
No Brushes,
No Commutator,
No Moving Wire,
Simplicity,
Durability,
Reliability,
Accuracy,
Even to a 6 c. p. Light.



DIAMOND ELECTRIC CO.,

MANUFACTURERS,

Office: 1202 Fisher Building, Chicago, Ill. Factory: Peoria, Ill.



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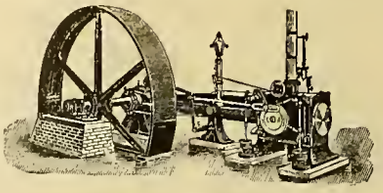

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SIMPLE AND COMPOUND.

Direct Connected when Desirable.

Tubular Boilers for all Pressures.

Complete Power Plants.

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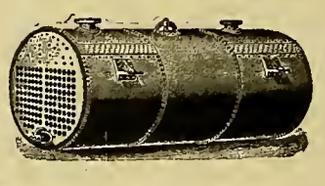

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Central Electric Co.
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Crown Woven Wire Brush Co.
Holmes Fibre-Graphite Co.
Partridge Carbon Co.

Burglar Alarms.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Husbel & Manger.
Partrick & Carter Co.

Cables (See Insulated Wires.)

Cables, Electric (See Insulated Wires), **Copper, Sheet and Bar.**
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Commercial El. Supply Co.
Eastern Electric Cable Co.
General Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
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Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

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Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
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California Asphalt Co.
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Okonite Co.
Reliable Elec. Supply Co.

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Electric Appliance Co.
Muir & Son, Thos.

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Roth Bros. & Co.
Sargent & Lundy.
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Ahlm-Edwards El. Co.
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Card Electric Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
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General Electric Co.
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Peoples Electric Co.
Roth Bros. & Co.
Sargent & Lundy.
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United Elec. Imp. Co.
Wagner Elec. Mfg. Co.
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Westinghouse Elec & Mfg Co.

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Mansfield Temp. Copper Co.
Mitchell Temp. Copper Co.

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Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
General Electric Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Reliable Elec. Supply Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

Cordage.
Central Electric Co.
Samson Cordage Wks.

Correspondence Schools.
Int. Correspond. Schools.

Crookes' Tubes.
Central Electric Co.
Commercial El. Supply Co.
Edison Lamp Dept.

Cross-Arms, Pins and Brackets.
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Central Mfg. Co.
Commercial El. Supply Co.
Electric Appliance Co.
Farr Tel. & Cons. Sup. Co.
Monona Cedar Co.
Point Marion Mfg. Co.
Reliable Elec. Supply Co.

Cut-Outs and Switches.
Bryant Electric Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Cutter El. & Mfg. Co.
Eddy Elec. Mfg. Co.
Electric Appliance Co.
Emerson El. Mfg. Co.
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General Elec. Co.
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Peru Elec. Mfg. Co.
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Westinghouse El. & Mfg. Co.

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Evans Electric Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Muir & Son, Thos.
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Central Electric Co.
Globe Electric Heating Co.

Electric Meters.
American El. Meter Co.
Zamel Arc Light Meter Co.

Electric Railways.
General Electric Co.
Westinghouse El. & Mfg. Co.

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McRae, A. L.
Sargent & Lundy.

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Commercial El. Supply Co.
Cutter El. & Mfg. Co.
Electric Appliance Co.
Emerson El. Mfg. Co.
General Electric Co.
Hill, W. S. Electric Co.
Keystone El. Instrument Co.
Paiste Co., H. T.
Queen & Co.
Reliable Elec. Supply Co.
Wagner Elec. Mfg. Co.
Weston Electrical Inst. Co.

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Central Electric Co.
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Hill, W. S. Electric Co.
Paiste Co., H. T.
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Thordarson, C. H.
Vought, M. I.

Electro-Plating Mach'y.
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Evans Electric Co.
General Electric Co.
Roth Bros. & Co.

Engines, Gas.
Foos Gas Engine Co.
Otto Gas Engine Wks.
Prouty Co., The.
Van Horne, Burger & Co.

Engines, Steam.
American Engine Co.
Ball Engine Co.
Murray Iron Works Co.
Weston Engine Co.

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Central Electric Co.
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Emerson El. Mfg. Co.
Farr Tel. & Cons. Sup. Co.
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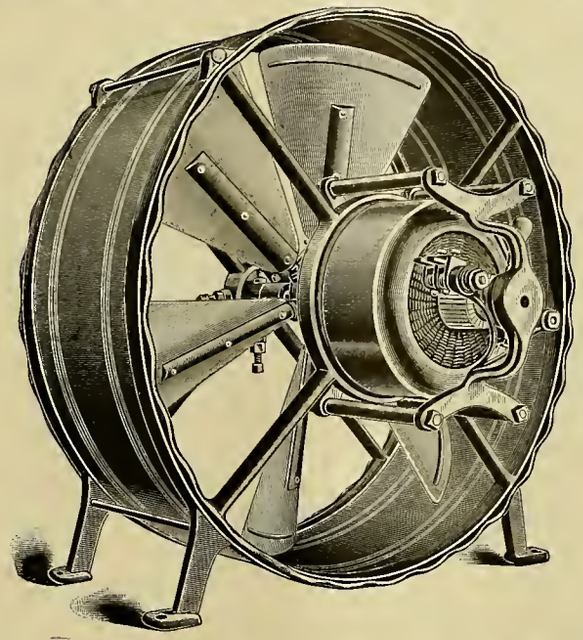

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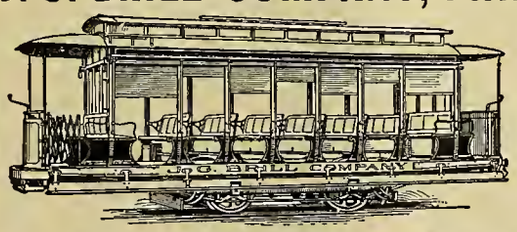

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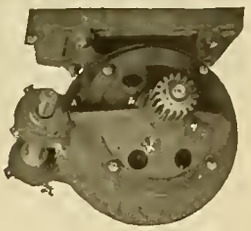

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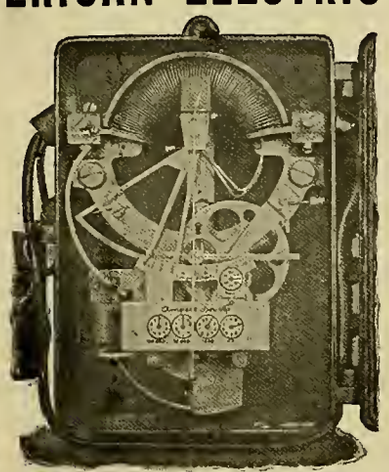

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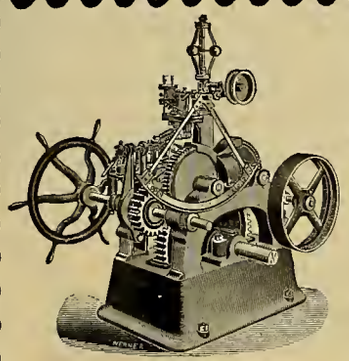

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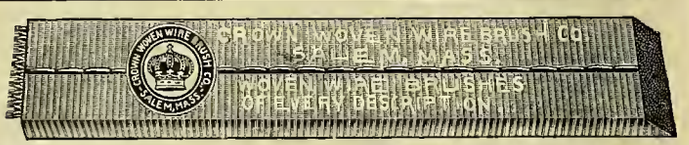

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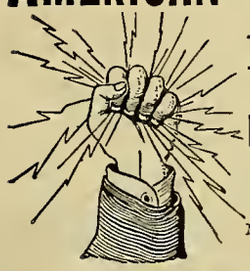

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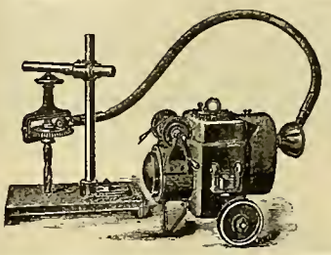

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Position as superintendent with an electric light company by a mechanical and electrical engineer of 14 years' experience in erecting and operating electric light plants; can give first-class references; go anywhere. Address "Engineer," care WESTERN ELECTRICIAN, 510 Marquette Bldg., Chicago.

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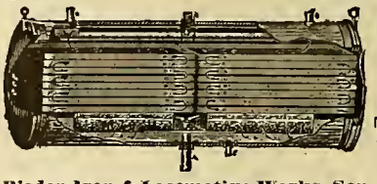

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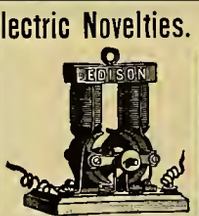

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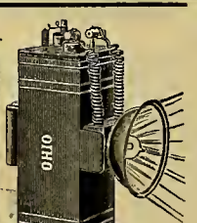

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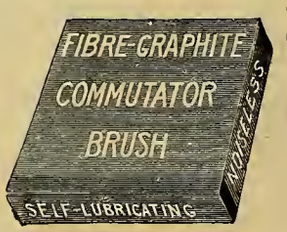

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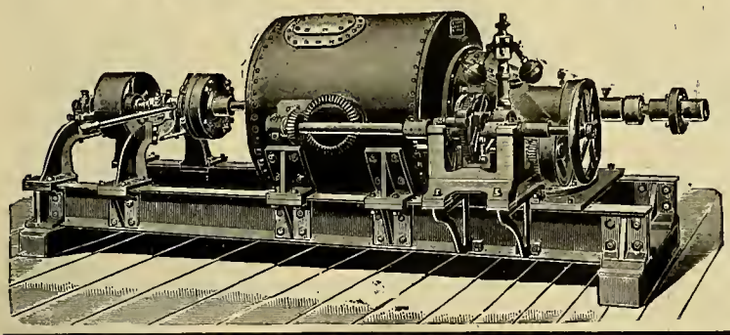

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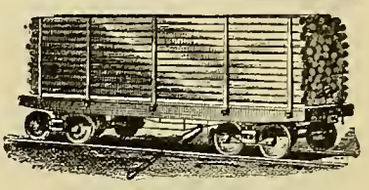

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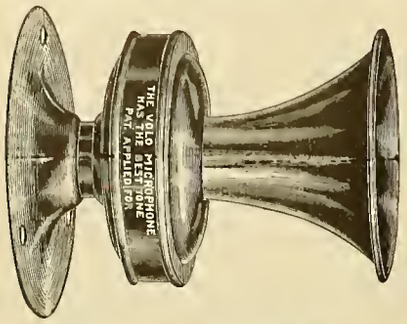

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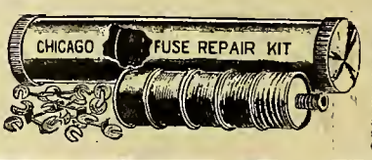

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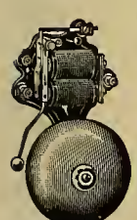

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All the books, accounts and correspondence of the old company are our property and will remain in our possession, therefore any reference to former correspondence will receive intelligent attention.

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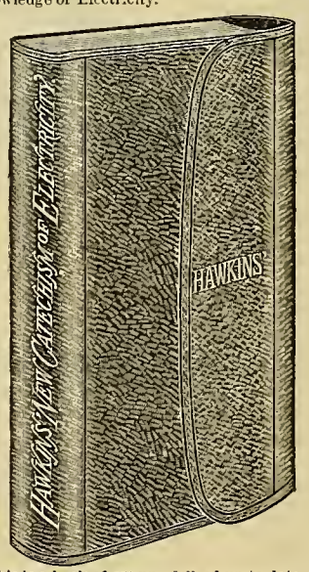

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IF there was any one subject which seemed to interest delegates at Niagara Falls, it was that of Air-Brakes. Air-Brakes were in the air and it was gratifying to notice the great interest taken in them.

Our exhibit was well located and we had the pleasure of having scores of visitors who made themselves at home. Our axle types were carefully looked over, but most attention was centered upon our motor compressor. This was in operation every few minutes during the Convention. Lots of railway men handled the interlocking device, blew the whistle and put the Compressor through its paces, and it stood the test, too!

Many delegates also rode on the cars in Buffalo on which thirty of our brakes are nearing their third year of successful operation. We were paid handsome compliments, based on their performance.

Now that recognition has come, we will say here that we are ready to equip any car or train with Air-Brakes. All inquiries promptly answered. We take this means of informing our friends that Mr. George E. Pratt, late General Manager of the Hunt Air-Brake Co., is now in our employ and will hereafter represent Standard Air-Brakes.

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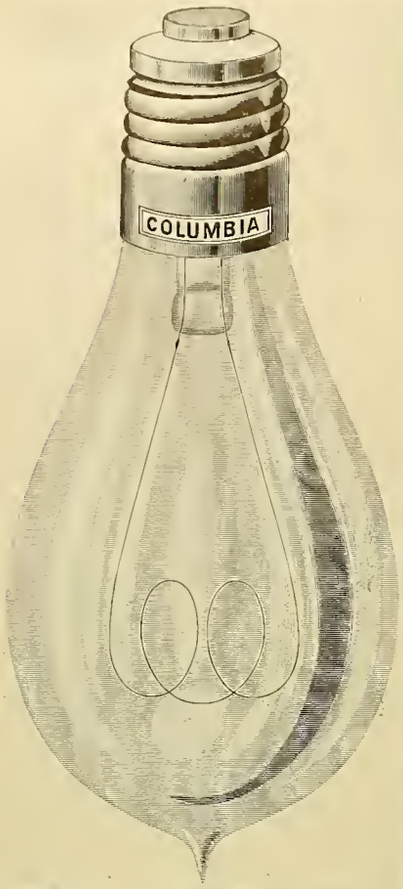

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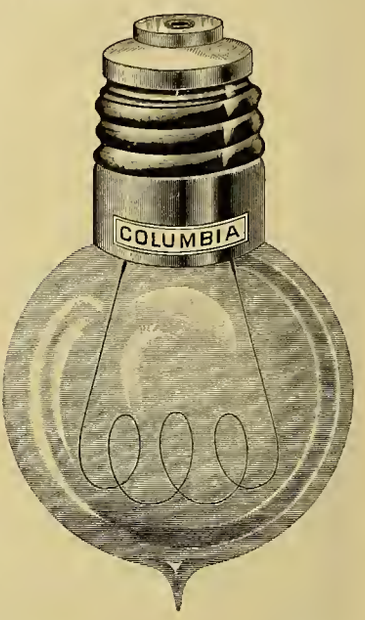

The cut shown herewith represents our new type of railway lamp. The consumption of current in these lamps is absolutely uniform. They are made low in economy and will give a most satisfactory life, and at the same time the candle power of the lamp will be excellently maintained. They possess many advantages over the old anchored type.

We also show herewith a cut of our small round bulb lamp which is well adapted for headlights for railway cars. This lamp takes the same amount of energy as our regular railway type and can be burned in series with it. It is a beautiful lamp also for decoration in cars for trolley parties.

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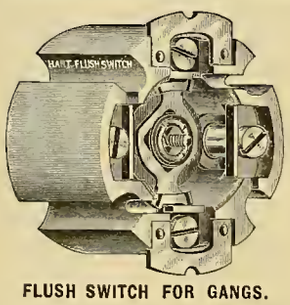

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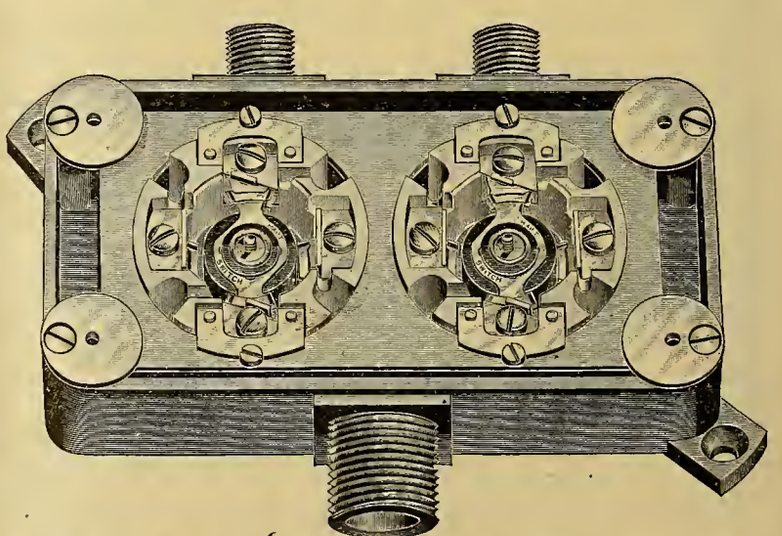

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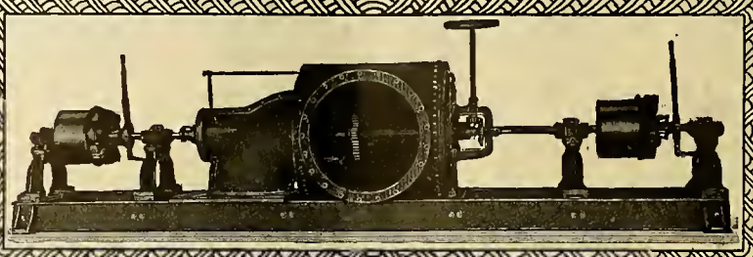

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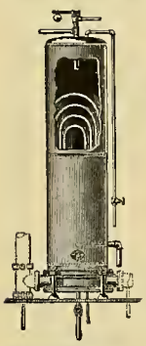

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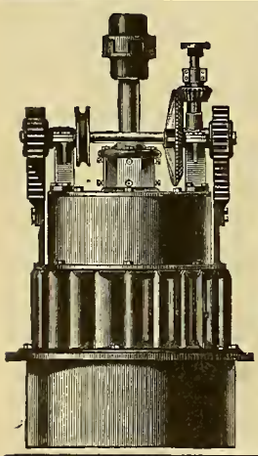

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7/8	15.04	138.12	155.03	223.61	84 55
3/4	15.11	127.67	133.24	191.06	83.68
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7/8	16.56	187.75	92.15	146.73	84.78
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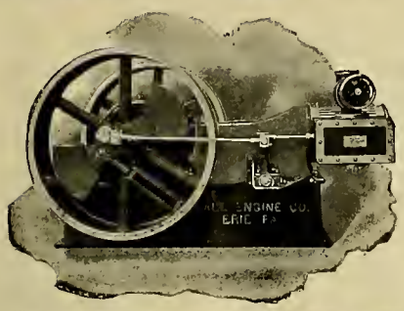

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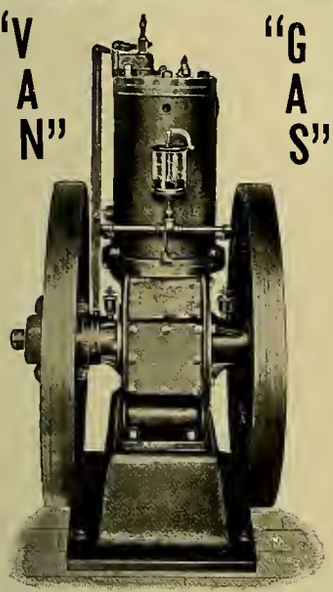

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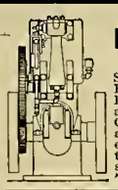

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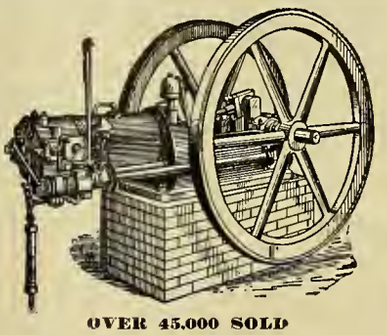

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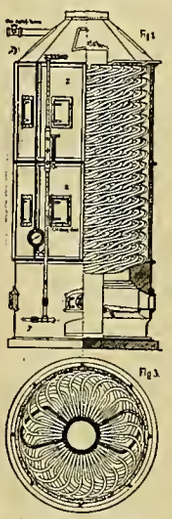

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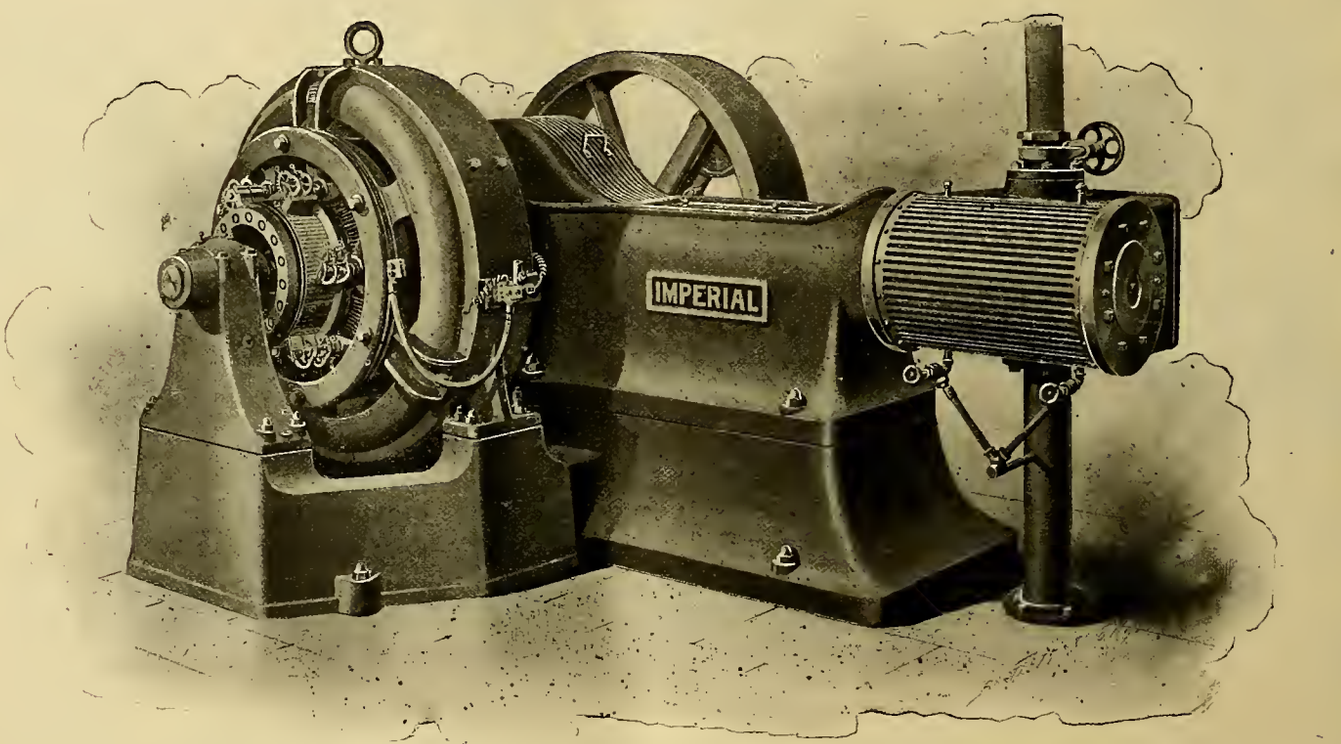

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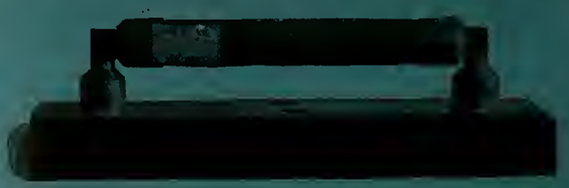

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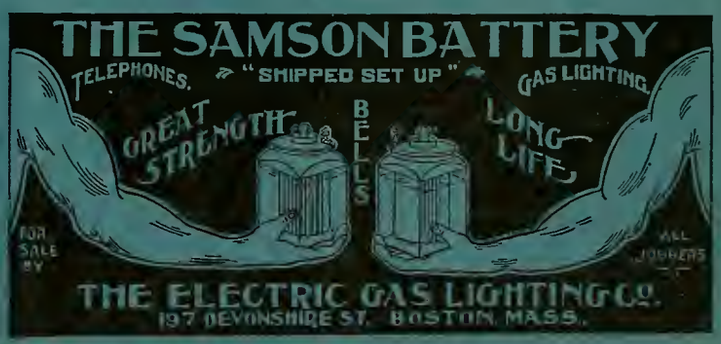

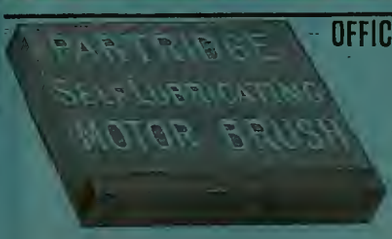

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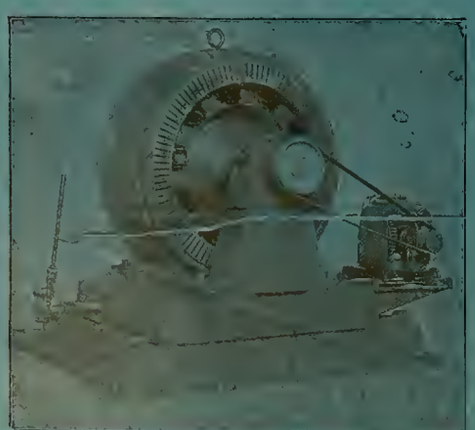

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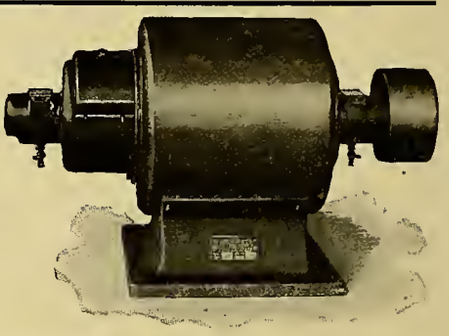

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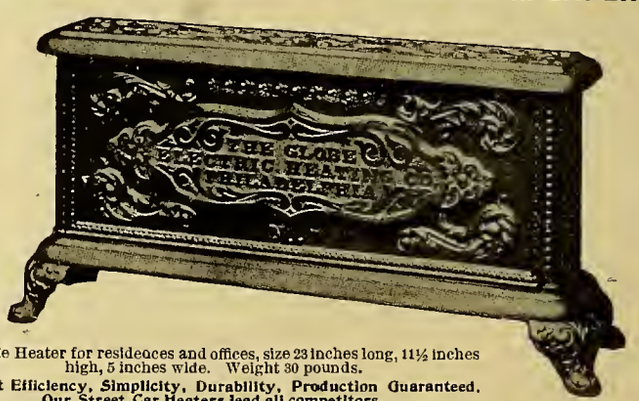

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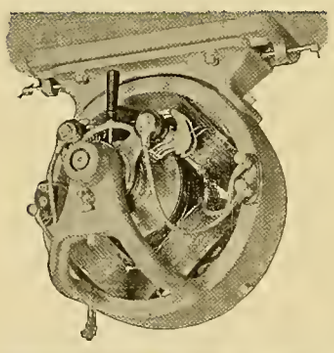

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Light Weight,
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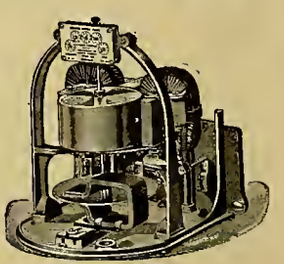
Convenient to Install.

No Brushes,
No Commutator,
No Moving Wire,
Simplicity,
Durability,
Reliability,
Accuracy.
Even to a 6 c. p. Light.



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Some Inducements in House Goods.

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Tin Speaking Tube T-Joints, 1 inch, 100 lots.....	3	cents each

Full lines in other departments at proportionally favorable prices.
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Type 610.

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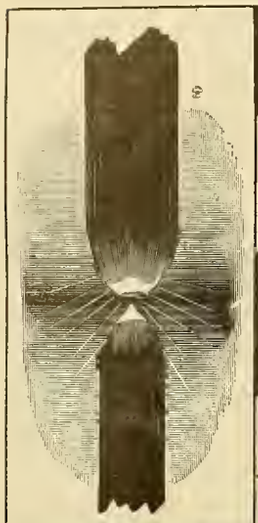

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Electric Storage Battery Co.
Willard El. & Battery Co.

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Cables, Electric (See Insulated Wires), **Copper, Sheet and Bar.**
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Int. Correspond. Schools.

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Wright, Wm.

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General Electric Co.
Roth Bros & Co.

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Otto Gas Engine Wks.
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Bryant Electric Co.
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Chicago Ins. Wire Co.
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Hill, W. S. Electric Co.
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Paiste Co., H. T.
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Phillips Insulated Wire Co.
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Simplex Electrical Co.
Standard Underground C. Co.
Wagner Elec. Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
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Chicago Edison Co.
Chicago Ins. Wire Co.
Commercial El. Supply Co.
Eastern Electric Cable Co.
Electric Appliance Co.
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Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
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Electric Appliance Co.
General Electric Co.
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(See Insulated Wires.)

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Garvin Machine Co., The.
Link-Belt Machinery Co.
Stilwell-Bierce Smith-Valle.

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Card Electric Co.
Central Electric Co.
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Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Evans Electric Co.
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Northern Electl. Mfg. Co.
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Peoples Electric Co.
Roth Bros. & Co.
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Stanley Elec. Mfg. Co.
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Triumph Electric Co.
United Elec. Imp. Co.
Wagner Elec. Mfg. Co.
Westinghouse El. & Mfg. Co
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Warren Electric Mfg. Co.
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Wright, Wm.

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Garlock Packing Co.
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Wright, Wm.

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Electric Appliance Co.
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Okonite Co., The.
Reliable Elec. Supply Co.
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Washburn & Moen Mfg. Co.

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Samson Cordage Wks.

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Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
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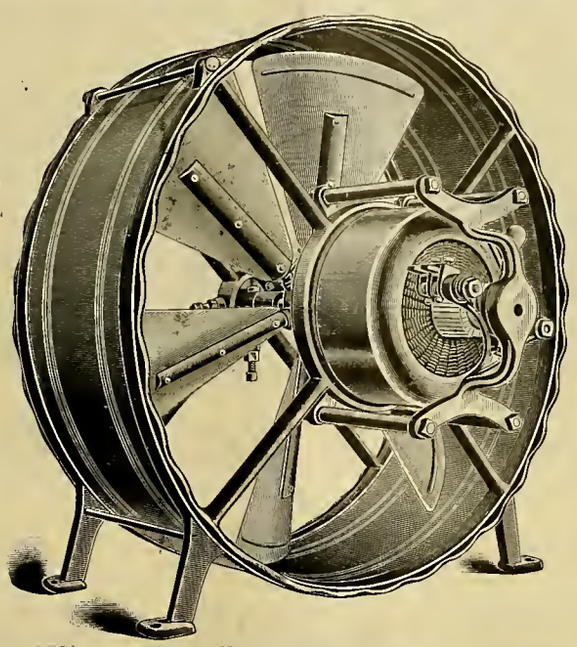
Are the most compact and efficient made.
Write for catalogue and prices.



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Highest Efficiency

Unbroken Magnetic Circuit, Self-Aligning Bronze Bearings. Finest Insulation Throughout. Four-Speed Regulator.

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The Electrician Publishing Co., Suite 510 Marquette Bldg., Chicago. Headquarters for all latest Electrical Books. Write for Catalogue.

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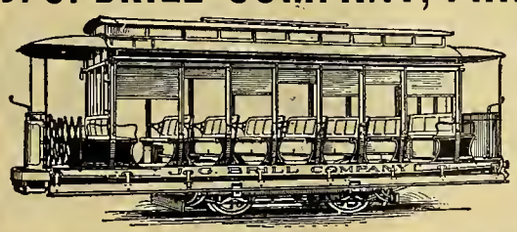

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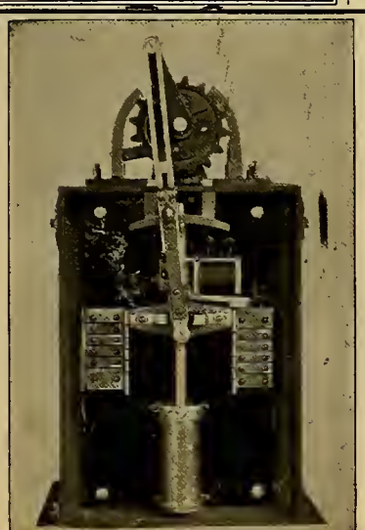

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DURABLE, PLAIN AND COMPACT.

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THE S. K. C. SYSTEM.

A COMPLETE SYSTEM FOR

Long Distance Transmission, General Station Distribution, Mill and Factory Equipment.

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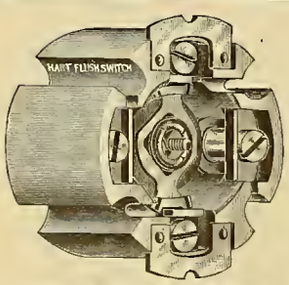
IN GANGS OF ANY NUMBER.

THE SWITCHES ARE INSERTED AND CONNECTED UP FROM THE FRONT.

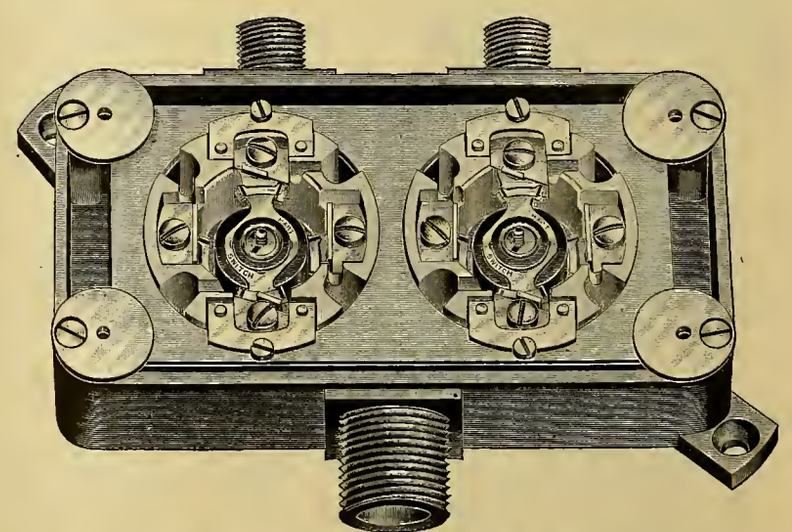


FLUSH SWITCH FOR GANGS.

The Cut shows a No. 2 Box for iron armored conduit, with a gang of two switches.

The boxes are furnished with any number of outlets desired.

Switches are "Indicating."



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FOR ENCLOSED LONG-BURNING ARC LAMPS.

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FOR DIRECT CURRENT ARC-LAMPS

FOR ALTERNATING CURRENT ARC-LAMPS

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Power with Every Stroke of the Piston.

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L. F BURGER.
E. A. PARROT.

Dayton, O., Oct. 5, 1897.

Western Electrician
Chicago

Gentlemen: We have been using your columns of your paper for four months, and find the results very satisfactory. We have sold six engines that can be traced to the paper, and made a number of agency contracts. We expect to continue our advertisement with you as long as we get such results.

Yours Truly
Van Horne, Burger & Co

Per V. P. Vanhorne

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AND SEVERAL OTHER STYLES,

ALL OF HIGHEST EXCELLENCE.

Pure Copper Switches and Switchboards.

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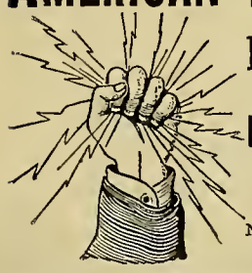

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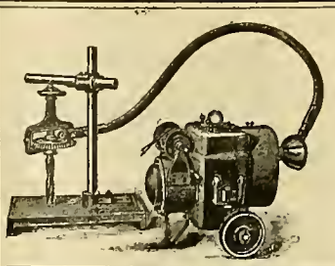

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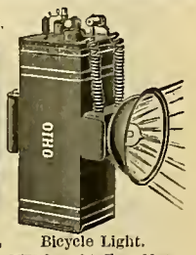

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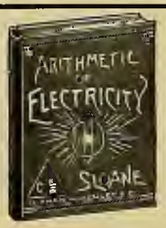

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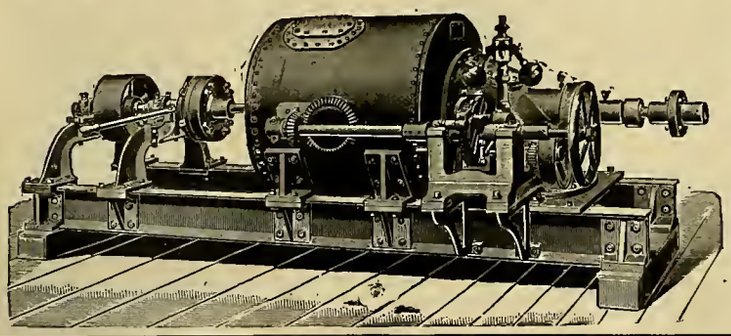

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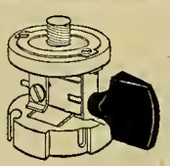

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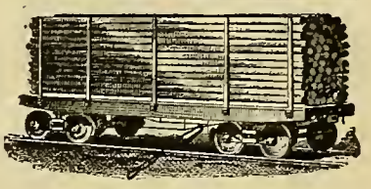

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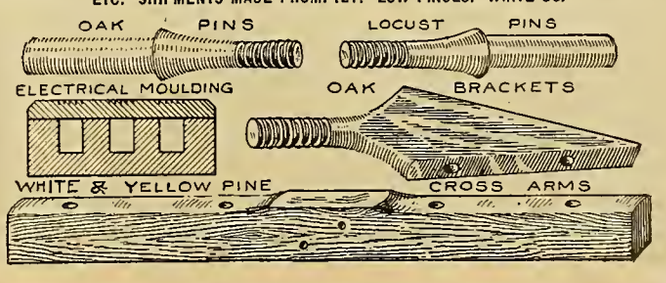

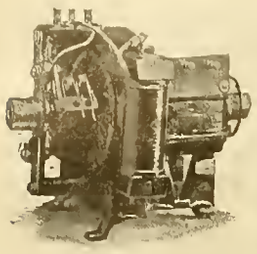

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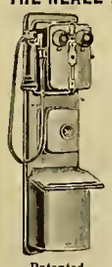

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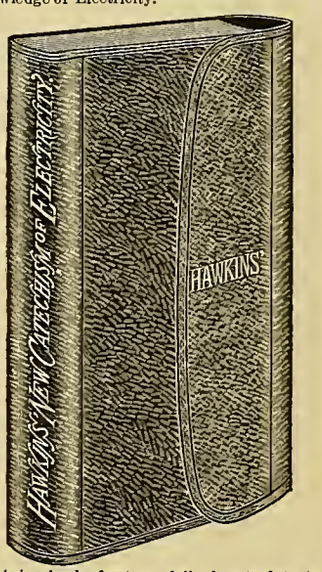

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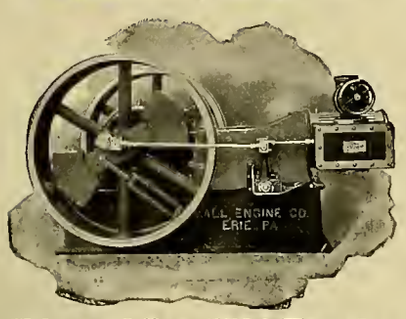

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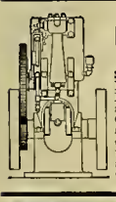

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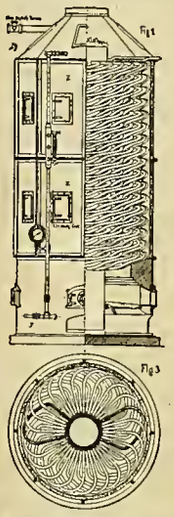

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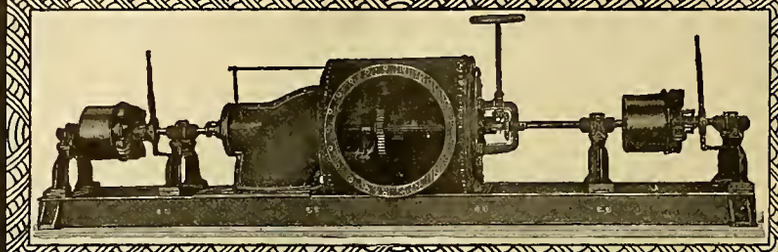

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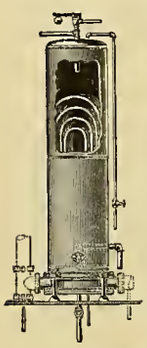

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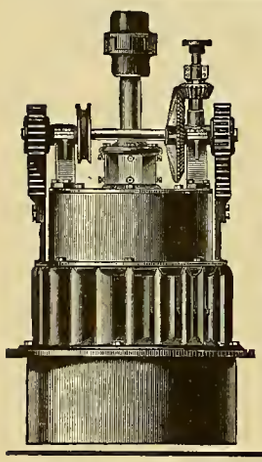

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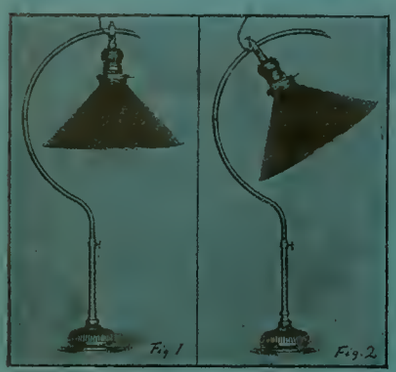

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Vol. XXI. CHICAGO, NOVEMBER 6, 1897. No. 19

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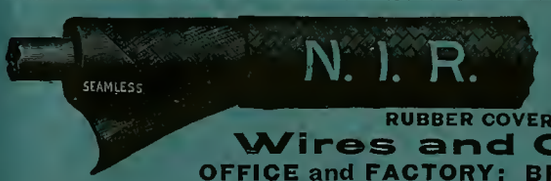

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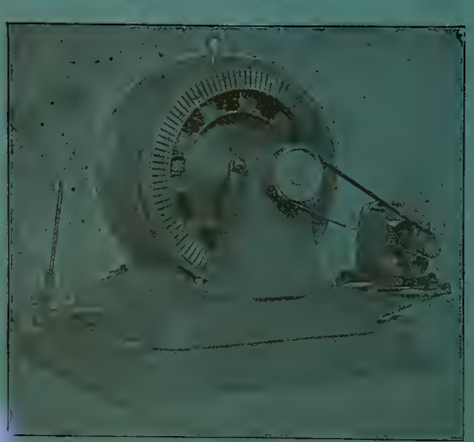

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AMERICAN CARBON CO.'S Plain and Coated CARBONS FOR SERIES ARC LIGHTING.

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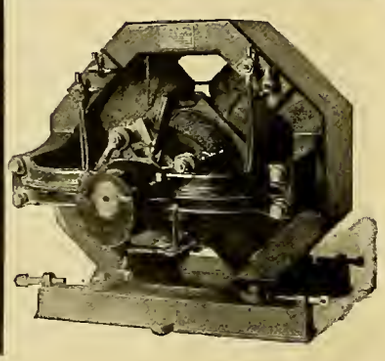

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PRICES GREATLY REDUCED.

WRITE YOUR JOBBER FOR REVISED FIGURES.

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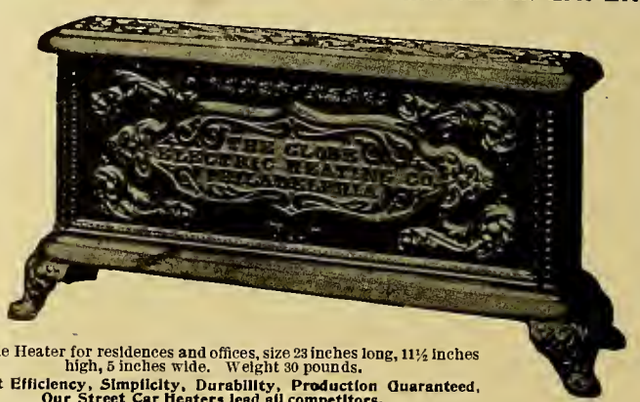

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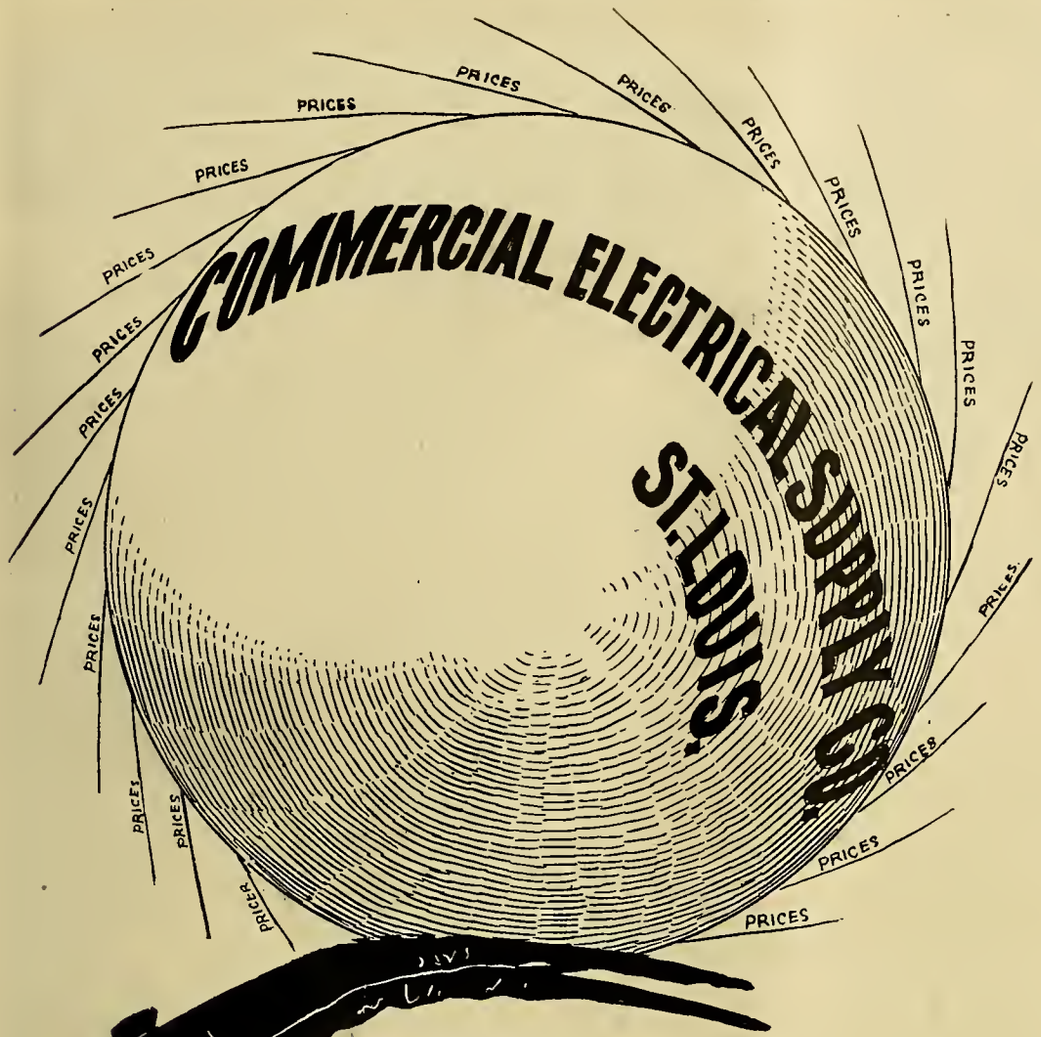

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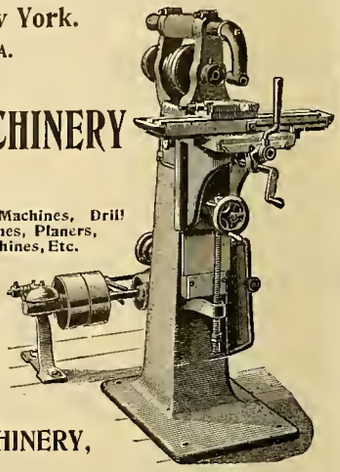

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Hodge, Walsh & Loring.
McFell Electric Co.
McRae, A. L.
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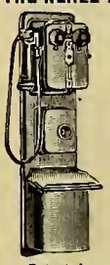

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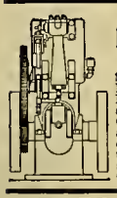

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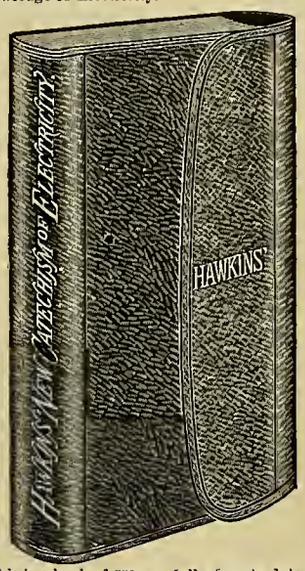

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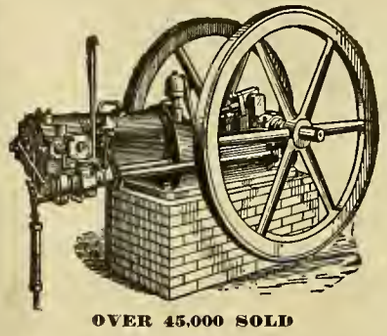

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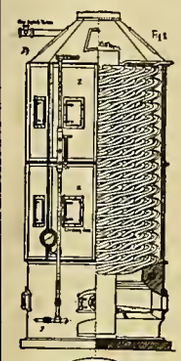

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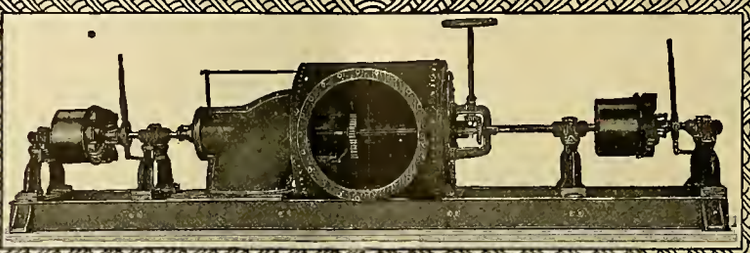

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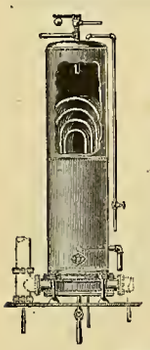

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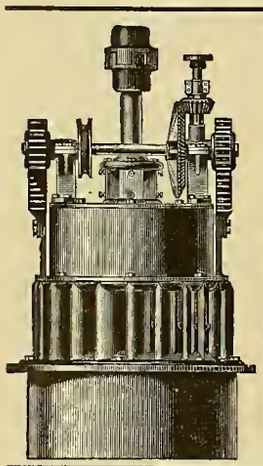

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¾	15.11	127.67	133.24	191.06	83.68	¾	17.33	178.50	83.95	138.40	83.88
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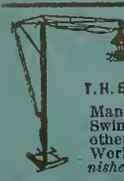
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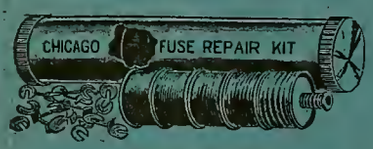

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Vol. XXI. CHICAGO, NOVEMBER 13, 1897. No. 20

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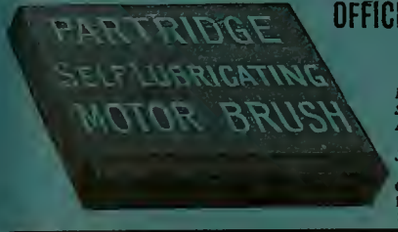

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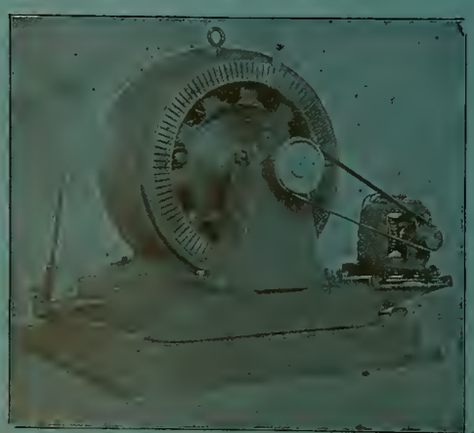

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Warren Electric Mf g. Co.

Contractors and Electric Light Plants.
Ahlm-Edwards El. Co.
Bain, Foree.
Card Electric Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
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Northern Electl. Mfg. Co.
Peoples Electric Co.
Roth Bros. & Co.
Sargent & Lundy.
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Wagner Elec. Mfg. Co.
Warren Electric Mfg. Co.
Westinghouse Elec & Mfg Co.

Conveyors.
Link-Belt Machinery Co.

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Central Electric Co.
Mansfield Temp. Copper Co.
Mitchell Temp. Copper Co.

Copper Wires.
American Electrical Works.
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Brixey, W. R.
Central Electric Co.
Chicago Edison Co.
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General Electric Co.
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Standard Underground C. Co.
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Samson Cordage Wks.

Correspondence Schools.
Int. Correspond. Schools.

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Commercial El. Supply Co.
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Central Mfg. Co.
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Point Marion Mfg. Co.
Reliable Elec. Supply Co.

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Eddy Elec. Mfg. Co.
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General Elec. Co.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Mankowitz, Sam'l.
Paiste Co., H. T.
Peoples Electric Co.
Peru Elec. Mfg. Co.
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Wagner Elec. Mfg. Co.
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Fuel Economizer Co.

Electric Heat'g App's.
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Globe Electric Heating Co.

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American El. Meter Co.
Zamel Arc Light Meter Co.

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General Electric Co.
Westinghouse El. & Mfg. Co.

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Sargent & Lundy.

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Electric Appliance Co.
Emerson El. Mfg. Co.
General Electric Co.
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Mankowitz, Sam'l.
Paiste Co., H. T.
Queen & Co.
Reliable Elec Supply Co.
Wagner Elec. Mfg. Co.
Weston Electrical Inst. Co.

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Reliable Elec. Supply Co.
Vought, M. I.

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General Electric Co.
Hobart Elec. Mfg. Co.
Nott & Co , A. D.
Roth Bros. & Co.

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Otto Gas Engine Wks.
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Roth Bros. & Co.
Wagner Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

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Files.
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Electric Appliance Co.

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Peerless Rubber Mfg. Co.

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Partrick & Carter Co.

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Farr Tel. & Cons. Sup. Co.
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Hill, W. S. Electric Co.
Mankowitz, Sam'l.
McKinlock & Camp, Agts.
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Paiste Co., H. T.
Partrick & Carter Co.
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Lombard Water Wheel Gv. Co.

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Holmes Fibre-Graphite Co.

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Central Electric Co.
Queen & Co.

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Bryant Electric Co.
California Asphalt Co.
Central Electric Co.
Chicago Edison Co.
Chicago Ins. Wire Co.
Commercial El. Supply Co.
Delaware Hard Fibre Co.
Diamond State Fibre Co.
Electric Appliance Co.
Emerson El. Mfg. Co.
Empire China Works.
Hill, W. S. Electric Co.
Kartavert Mfg. Co.
Mankowitz, Sam'l.
Mass. Chemical Co.
Mica Insulator Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Paiste Co., H. T.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Phillips Insulated Wire Co.
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Wagner Elec. Mfg. Co.

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American Electrical Works.
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Moore, Alfred F.
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New York Insulated Wire Co.
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Phillips Insulated Wire Co.
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Electric Appliance Co.
General Electric Co.
Westinghouse El. & Mfg. Co.

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(See Insulated Wires.)

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Link-Belt Machinery Co.
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Link-Belt Machinery Co.
Westinghouse El. & Mfg. Co.

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Central Electric Co.
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Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
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General Electric Co.
Hobart Elec. Mfg. Co.
Mankowitz, Sam'l.
Northern Electl. Mfg. Co.
Ohio Electric Works.
Peoples Electric Co.
Roth Bros. & Co.
Sargent & Lundy.
Stanley Elec. Mfg. Co.
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Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co
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Wright, Wm.

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Garlock Packing Co.
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Peerless Rubber Mfg. Co.

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Besly & Co., Chas. H.
Phosphor Bronze Sm. Co. Ltd.

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Baker & Co.

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Emerson El. Mfg. Co.
Partrick & Carter Co.

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Swarts Metal Refining Co.

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Iron Clad Rheostat Co.
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Cornman Co.
Electrical Exchange, The.
Elliott, W. H. Elec. Co.
Hartley Electric Works.
Hodge, Walsh & Loring.
Wright, Wm.

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Central Electric Co.
Electric Appliance Co.
Partrick & Carter Co.

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Keystone El. Instrument Co.
Queen & Co.
Weston Electrical Inst. Co.

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Bossert Elec. Const. Co.

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National Tube Works Co.

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Electric Storage Battery Co.
Willard El. & Battery Co.

Tapes, Insulating.
American Electrical Works.
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Commercial El. Supply Co.
Electric Appliance Co.
Moore, Alfred F.
New York Insulated Wire Co
Okonite Co., The.
Reliable Elec. Supply Co.
Simplex Electrical Co.
Washburn & Moen Mfg. Co.

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Commercial El. Supply Co.
Farr Tel. & Cons. Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Kusel, D. A. Tel. & El. Mfg. Co.
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McFell Electric Co.
Mo. Tel. Mfg. Co.
Peoples Electric Co.
Rawson Electric Co.
Reliable Elec. Supply Co.
Snyder, Wm. M.
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Stromberg-Carlson Tl. M. Co.
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Viaduct Mfg. Co.
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Carlisle & Finch Co.

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Roth Bros. & Co.
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Wagner Elec. Mfg. Co.
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Samson Cordage Wks.

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General Electric Co.
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Dayton Globe Iron Works Co
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Water Wheels.
Am. Impulse Wheel Co.
Dayton Globe Iron Works Co
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Wire, Bare.
Besly & Co., Chas. H.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Standard Underground C. Co
Washburn & Moen Mfg. Co.

X Ray Outfits.
Central Electric Co.
Commercial El. Supply Co.
Edison Lamp Dept.
Queen & Co.

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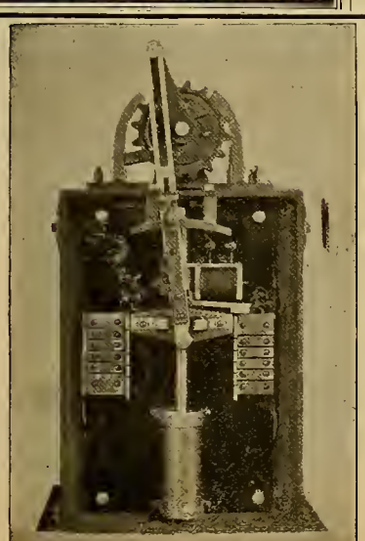

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1128 MARQUETTE BUILDING

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Address All Communications to Office.

Chicago, November 8th, 1897.

Western Electrician,

510 Marquette Bldg.,

City.

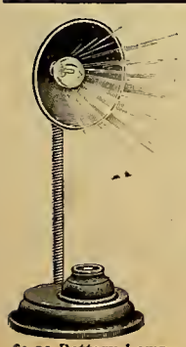
Gentlemen:-

In simple justice to your paper, we feel called upon to state, that the results obtained from advertisement in your columns, have exceeded our expectations. We have been liberal in advertisement, yet have insisted that such advertisements should at least pay for themselves in results, and the orders that we can trace directly to the Western Electrician, both in this country and in foreign countries, justifies the statement, that such advertisements have been a profitable investment. So long as the present results continue, we shall feel it incumbent upon ourselves to continue an advertisement in the Western Electrician.

Very truly yours,

K. McLennan & Co.

Dic by M.J.I.



$1.50 Battery Lamp. Used with dry batteries.

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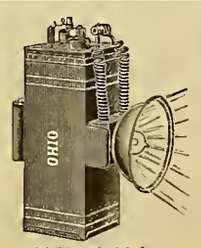
Necktie Light.

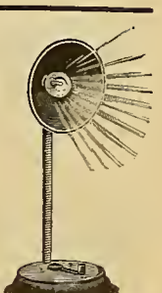
Dollar Motor.

Scarf Pin.

We are headquarters for the goods that pay the profit. Send for prices to the trade, and our new catalogue, just issued. We want agents.

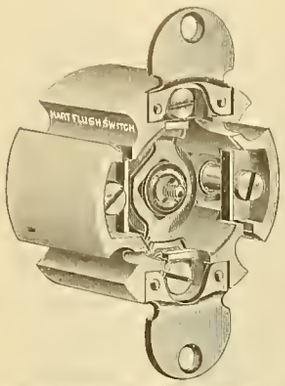


$6 Bicycle Lights, $2.50.

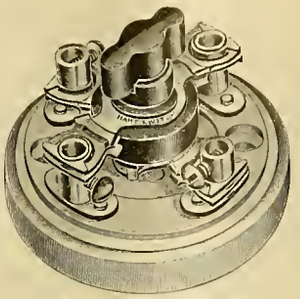


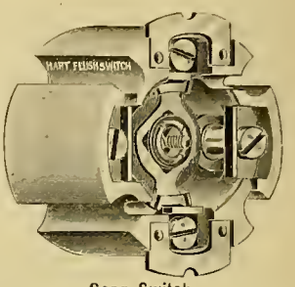
$1.50 Student Lamp. For acid or storage battery.

Ohio Electric Works, Cleveland, O.



Flush Switch with Plate Removed.


10 Ampere, Double Pole.



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"Nothing succeeds like success." Hart Switches have been manufactured since 1890. Each year our sales have grown larger. Each year we have made some improvement in quality. Our Switches today are better and sales larger, than ever before. We build for active service---not for the bargain counter and scrap heap. A chain is no stronger than its weakest link. Switches are links in electric circuits. A defective or poorly constructed switch is worse than worthless---it is a constant source of danger, annoyance and expense. Make your next order read "HART" Switches and you will be well pleased with value received. Your dealer carries a full stock of Hart Switches and will ship without delay.

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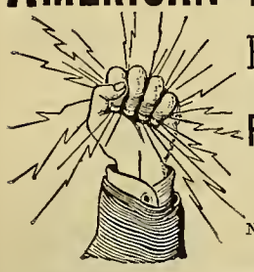
St. Louis, Mo., Western Electrical Supply Co.

EUGENE F. PHILLIPS, Prest. F. N. PHILLIPS, Treas. W. H. SAWYER, Secy.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



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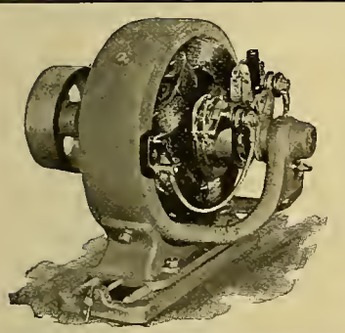

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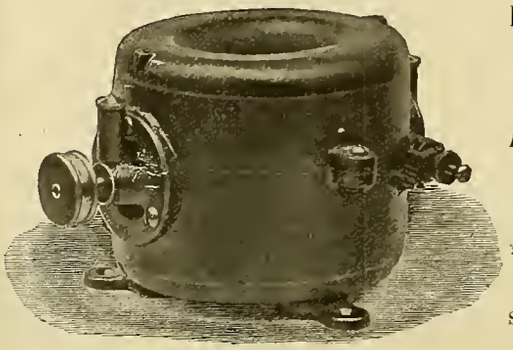

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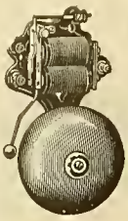

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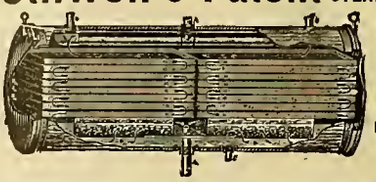

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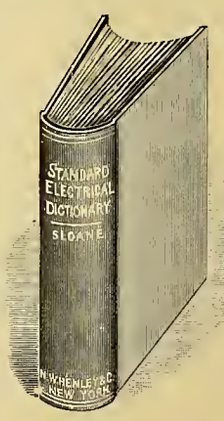

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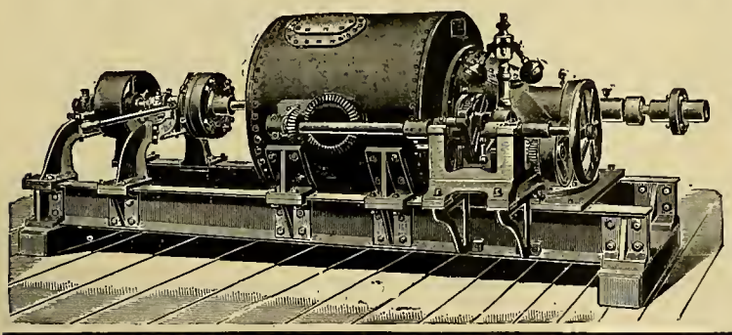

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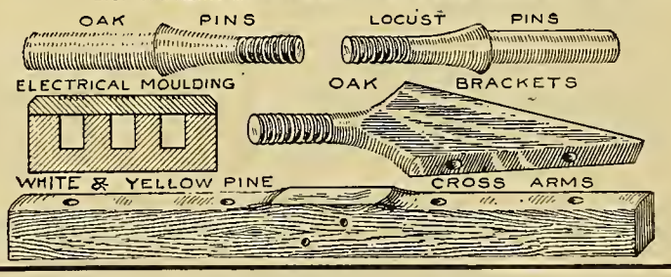

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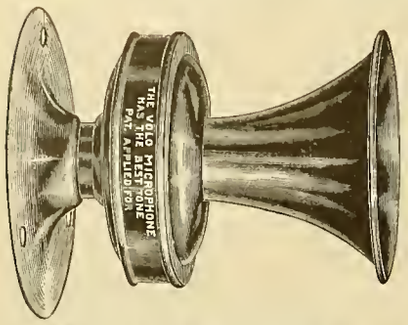

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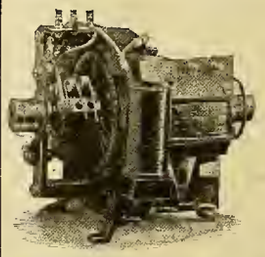

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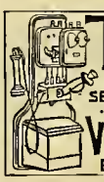

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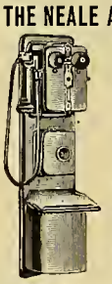

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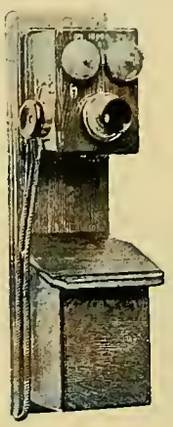

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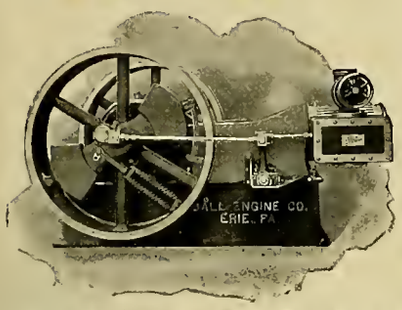

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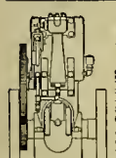

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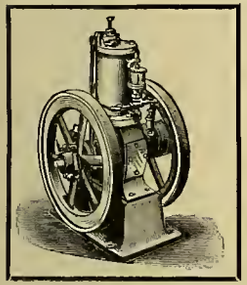

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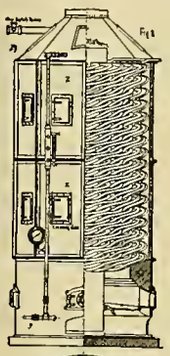

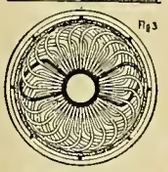

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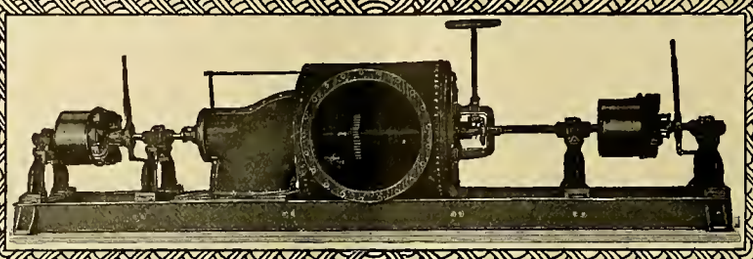

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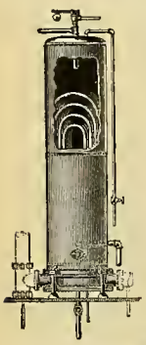

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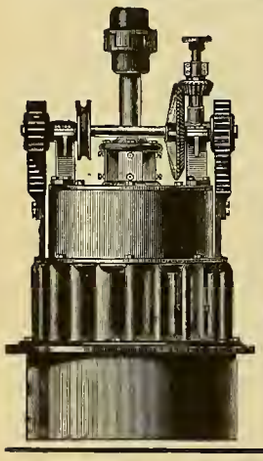

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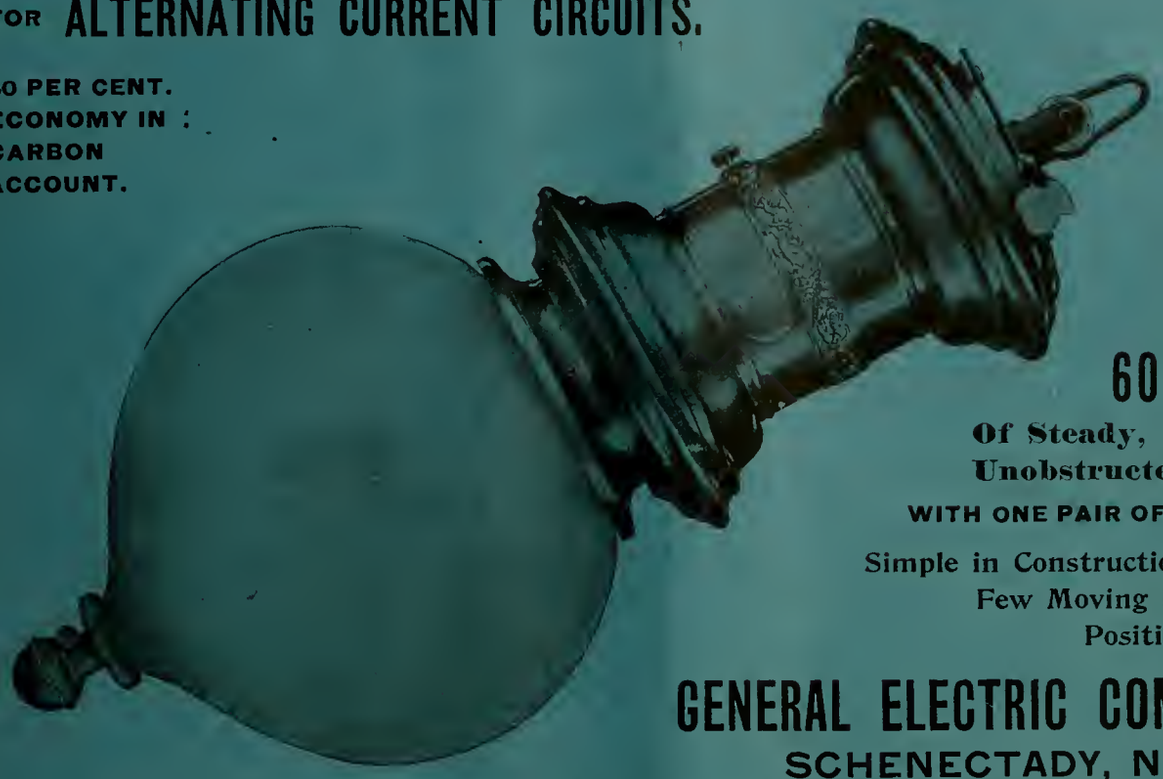

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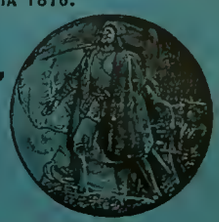

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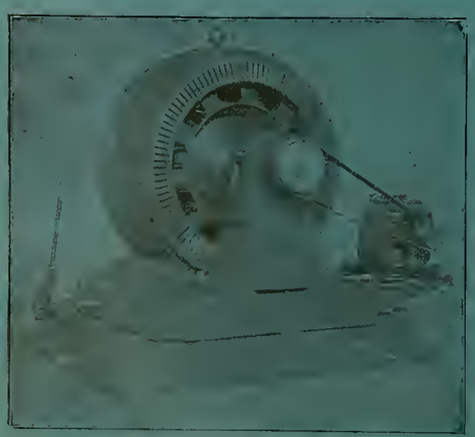

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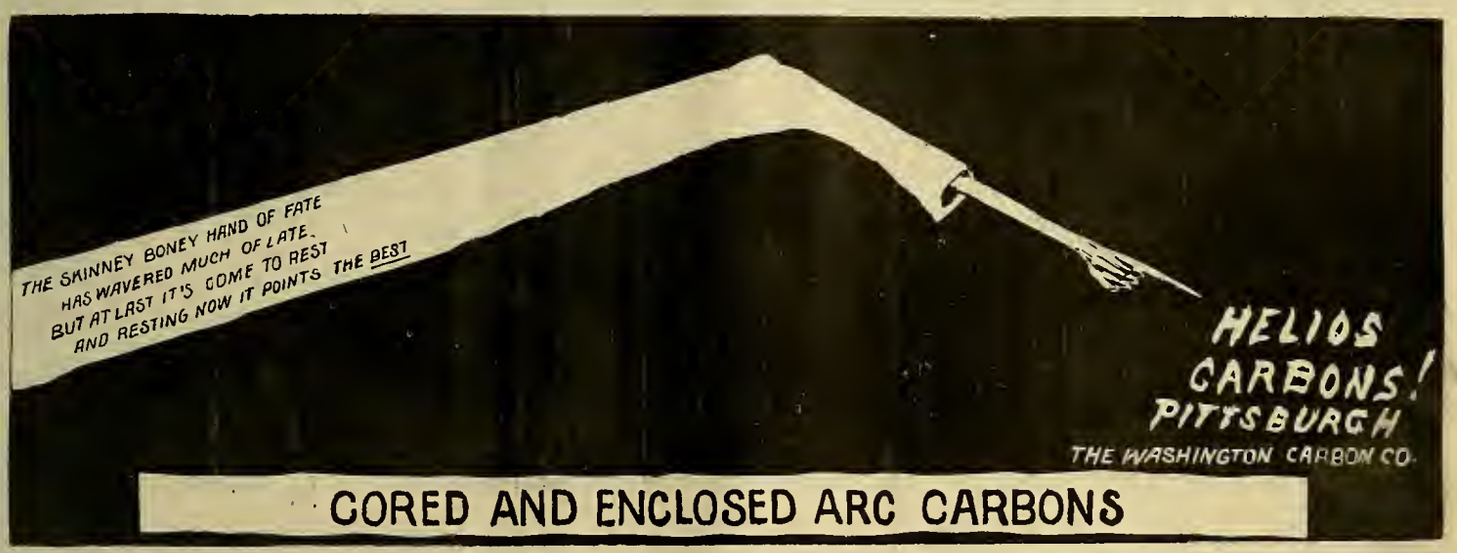

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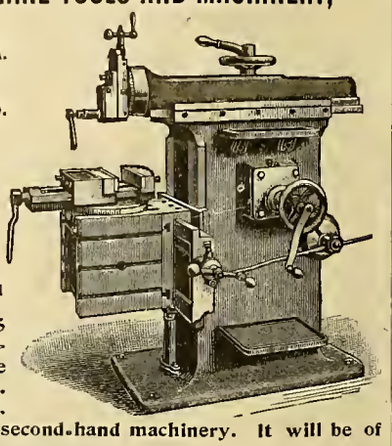

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Direct Coupled to Exhaust Wheels, wound for any current except alternating.

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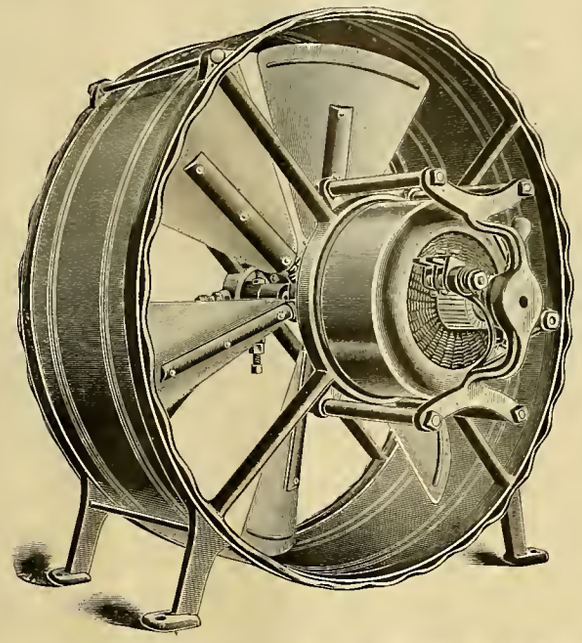

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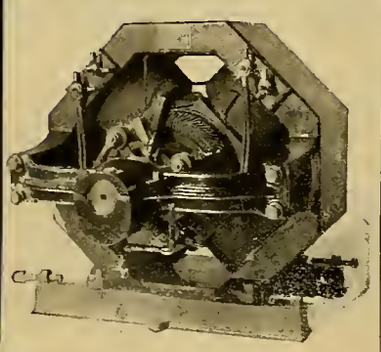

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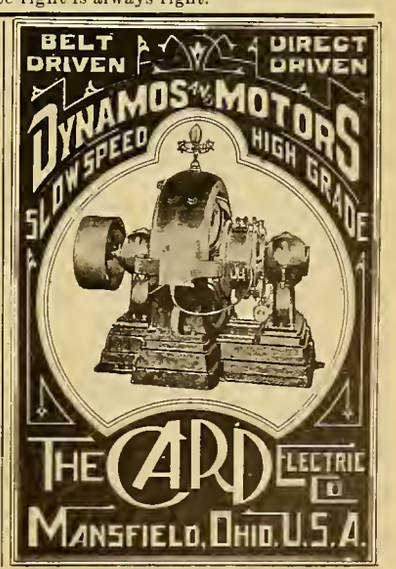

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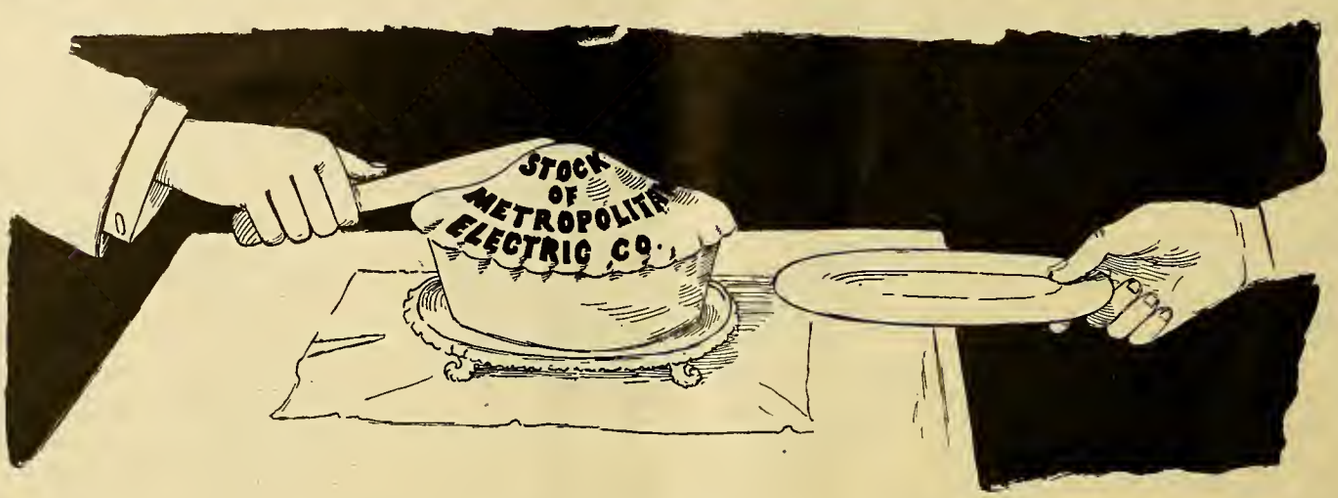

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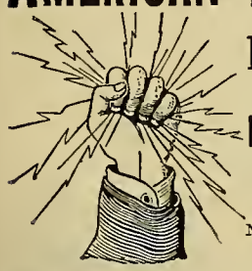

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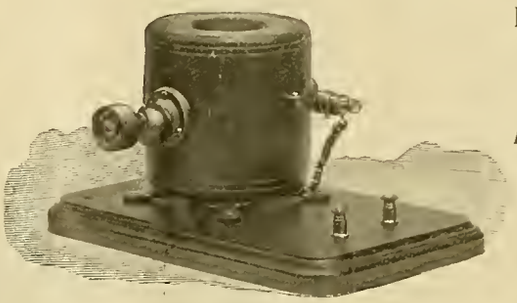

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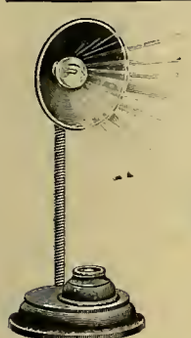

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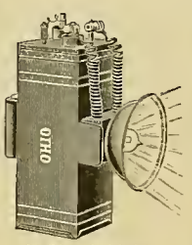

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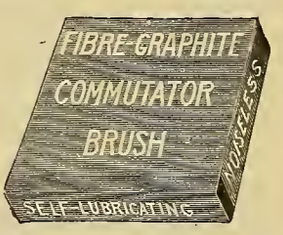

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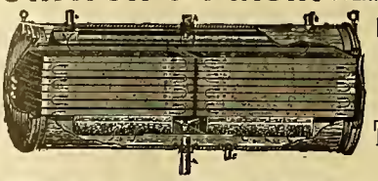

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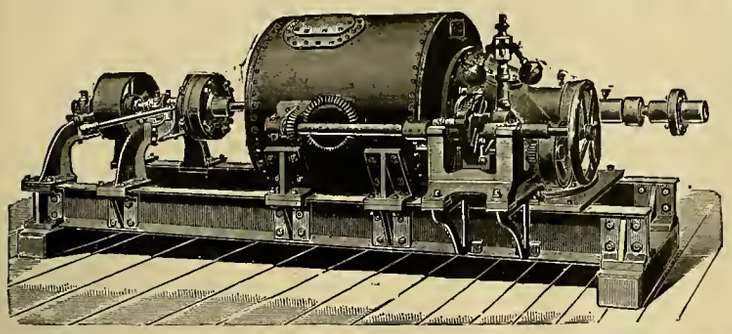

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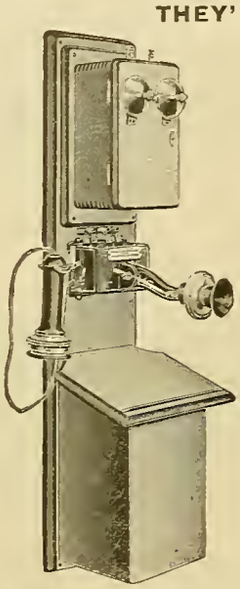

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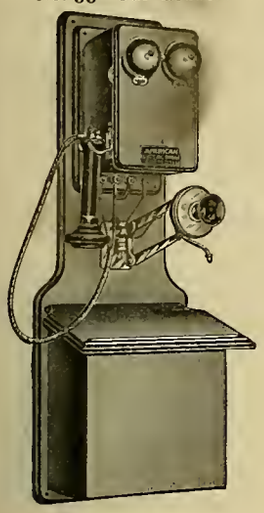

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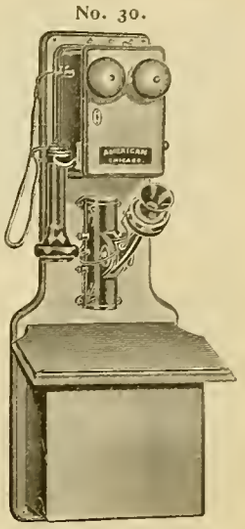

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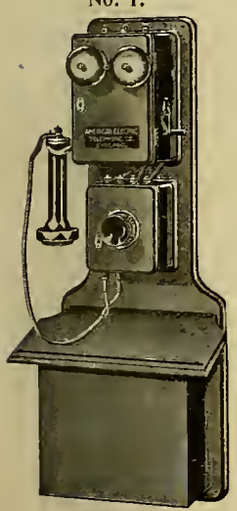

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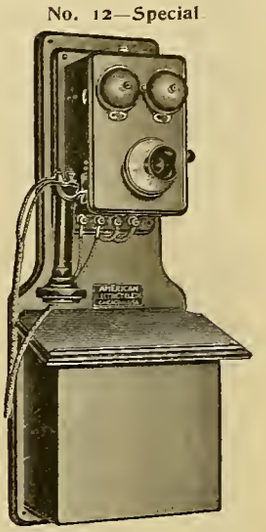

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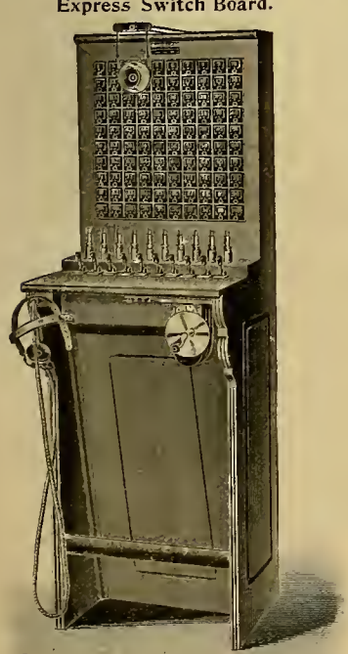

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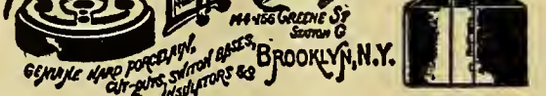

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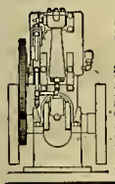

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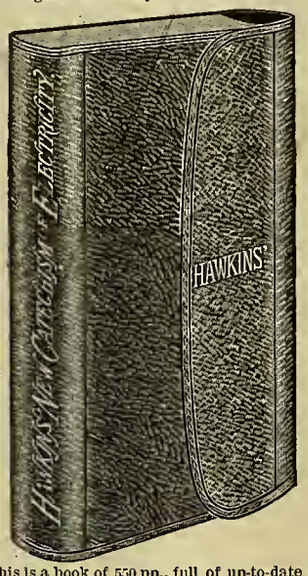

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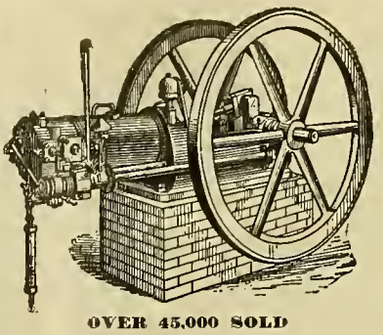

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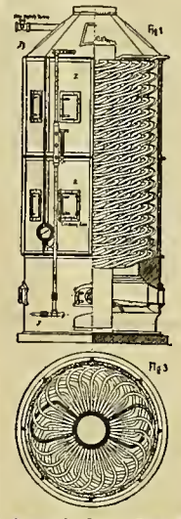

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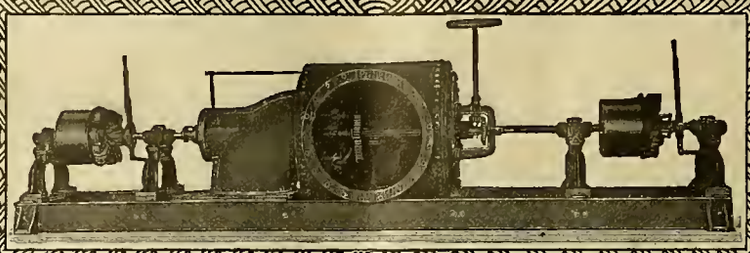

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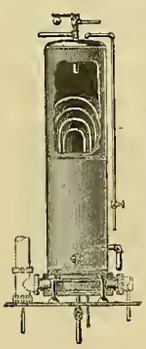

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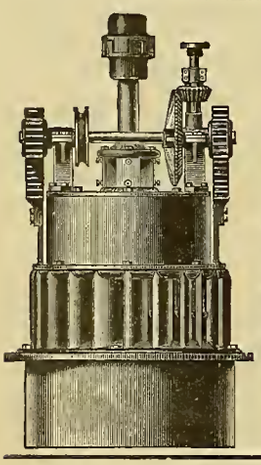

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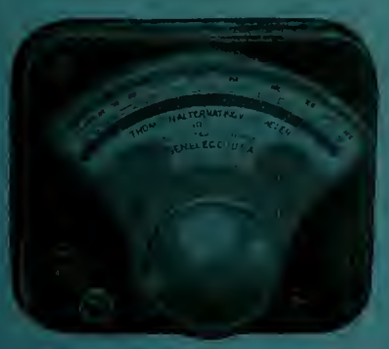

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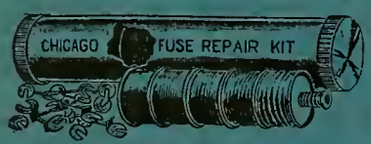

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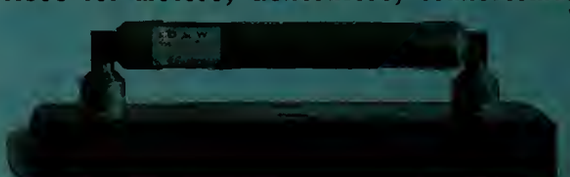

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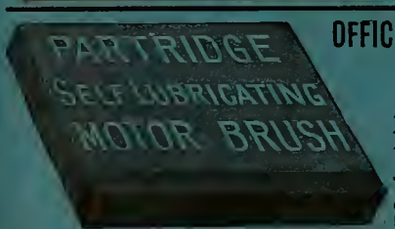

OFFICE AND FACTORY, SANDUSKY, O.

—AGENTS—

Mayer & Englund, 10 S. 10th St., Phila., Pa.
Smith & Wallace, Hamilton St., Boston, Mass.
Arthur S. Partridge, Bank of Commerce Bldg., St. Louis, Mo.
Joshua Hendy Machine Works, 42 Fremont St., San Francisco.
Central Electric Co., 173 Adams St., Chicago.
Harry M. Shaw, 120 Liberty St., New York.
Schmiake & Newman, New Orleans, La.

"Two Balls" Adjustable Hanger.

Automatic. Perfection.

M. I. Vought,

ELECTRICAL SPECIALTIES, LA CROSSE, WIS.

GREEN'S ECONOMIZER

For Steam Boilers. SAVES 10% TO 20% IN FUEL.

SOLE MAKERS IN THE U. S. A.

THE Fuel Economizer Co.,

MAIN OFFICE AND WORKS: MATTEAWAN, N. Y.

BRANCH OFFICES: 74 Cortlandt St., New York; 321 Exchange Bldg., Boston, Mass.; 1540 Marquette Bldg., Chicago; 32 First St., San Francisco, Cal.

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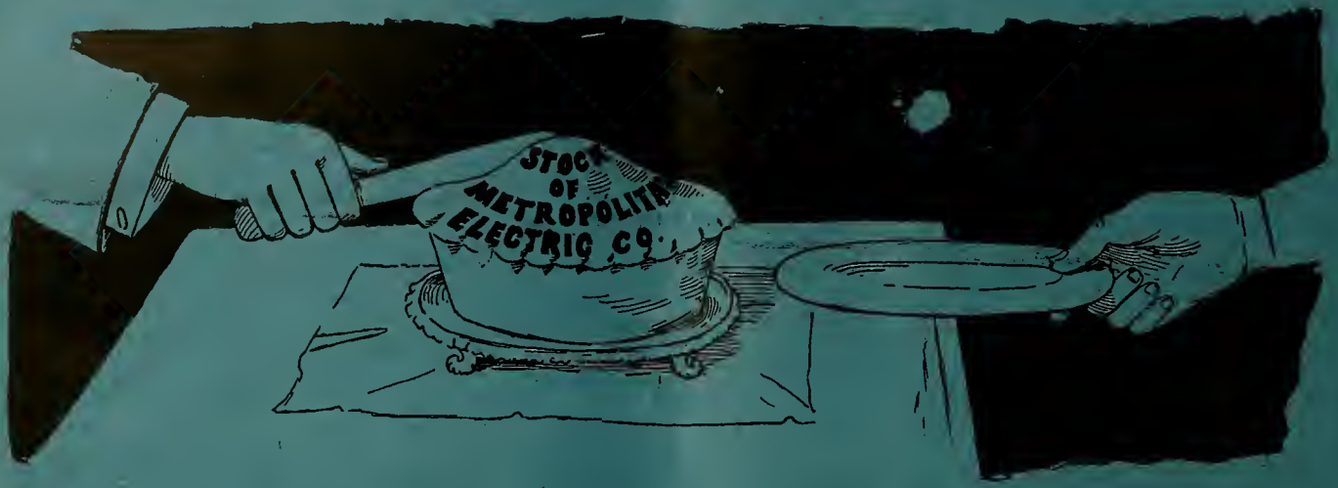

SEND AND GET A SLICE!

GUARANTEE TO BEAT ANY PRICE ON THE MARKET.

The stock consists of RUBBER COVERED WIRE, Weatherproof Wire, Magnet Wire, Porcelain and Clay Wiring Tubes, Incandescent Lamps, Carbons, Tools of all kinds, House Annunciators, Push Buttons, and a general assortment of Electric Supplies of standard manufacture.

Send in your orders and try us, or let us quote you FIRST.

WM. H. McKINLOCK, - W. C. CAMP, AGENTS,

186-188 FIFTH AVENUE, CHICAGO.

CARBONS

FOR ENCLOSED LONG-BURNING ARC LAMPS.

"ELECTRA"

FOR DIRECT CURRENT ARC-LAMPS

FOR ALTERNATING CURRENT ARC-LAMPS

ELECTRA ELECTRA

HIGHEST GRADE NUERNBERG CARBONS

UNEQUALLED IN QUALITY AND EFFICIENCY

ABSOLUTELY STEADY AND BRILLIANT LIGHT.

HUGO REISINGER 38 BEAVER ST. NEW YORK.

CARBONS

PIONEER $25

We have completed our new manufacturing plant, which enables us to reduce the selling price of the

PIONEERS IN ENCLOSED ARC LIGHTING

PIONEER ENCLOSED ARC LAMP.

We offer the consumer the benefit of this, in the shape of a reduction from **$30** to **$25** per lamp.

Manufactured under Basic Enclosed Arc Lamp Patents of L. B. Marks, Marks-Ransom and others.

ELECTRIC ARC LIGHT CO., 150 Nassau St., New York.

YOUR SUPPLY MAINTAINED FOR 12c.

LAMPS Efficient, Long-Lived and Guaranteed Satisfactory.

Write us before making another contract. We are **THE** Lamp Renewing Company you have heard of.

Lynn Incandescent Lamp Co., Lynn, Mass.

GORDON PRIMARY CELL.

For Open and Closed Circuit Work.

The Perfect, Modern, Longest Lived and Most Economical Cell Ever Put on the Market.

In use by the leading cities, railroads, telephone and gas engine companies.

WE CLAIM:—Constant discharge of current without polarization; no local action; no noxious gases or fumes; no acids; least labor for operation; cleanest; not freezing at 28° below zero; economic value 50 per cent. greater than gravity cell, and 30 per cent. greater than best other cell in market. For No. 1 cell, 250 ampere hours; for No. 2 cell, 100 ampere hours; on open circuit, .9 to 1 volt; on closed circuit, .65 to $\frac{7}{10}$ volt. Send for circular and price list.

THE GORDON-BURNHAM BATTERY CO.,

82 to 86 West Broadway, New York City.

GEO. W. PATTERSON, 1114 Marquette Bldg., Chicago, Ill.

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HARDTMUTH CORED CARBONS for Direct and Alternating Current ARC LAMPS.

HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

AMERICAN CARBON CO.'S Plain and Coated CARBONS FOR SERIES ARC LIGHTING.

GENERAL WESTERN AGENTS.

HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

Chicago Edison Co.,

DEALERS IN ELECTRIC LIGHTING SUPPLIES,

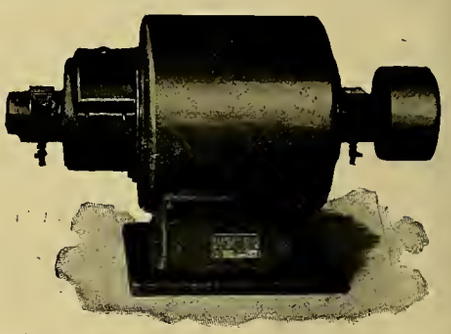
139 Adams Street, CHICAGO.

Now, boys, you've had a good rest—get ready for next month—new tune—same old words:—

"Low prices—big stock—
"Quick shipment to you.
"Some quote 'bed-rock' (?)
"We always do!"

THE . . .

Storey Motors.



Iron-clad. Completely Closed In. Dust and Moisture Proof. No External Magnetism.

Specially Adapted for Direct Connection to Machinery.

Special Direct Current Motors for All Classes of Work.

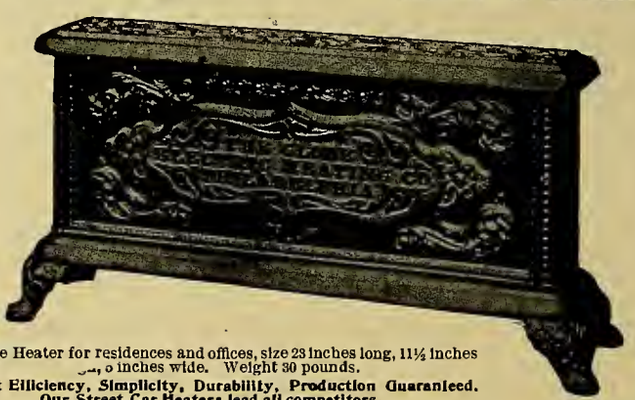
THE STOREY MOTOR & TOOL CO.,

MAIN OFFICE AND FACTORY: 212-226 Ionic St., (FORMERLY CARTER ST.,) Philadelphia, Pa.

BRANCH FACTORY: Hamilton, Canada.

Cable address, Storey, Philadelphia. A B C Code used.

ELECTRIC HEATERS AVAILABLE TO ALL. MINIMUM EXPENSE.



Portable Heater for residences and offices, size 23 inches long, 11½ inches [illegible], 9 inches wide. Weight 30 pounds.

Highest Efficiency, Simplicity, Durability, Production Guaranteed. Our Street Car Heaters lead all competitors.

Send for new illustrated circular.

Heating coils renewed like incandescent lamps. Constructed for any voltage. Work on direct or alternating current. Consumes 6. 8 amperes on 110 volt current, 1. 5 on 500 volt current.

THE GLOBE ELECTRIC HEATING CO., 147 North 12th Street, Philadelphia, Pa.

SEE THESE PRICES!

Weatherproof Wire, all sizes to No. 8, per lb	$0.13¾
Rubber-covered Wire, No. 14, per 1,000 feet	7.50
Shaffer-Paiste Rosettes, concealed or cleat, each	.05¾
Iron Box Bells, 100 lots	.19½
Wood Push Buttons, each	.04
Dry Batteries, each	.18
Metal Push Buttons	.09

(OTHER SPECIALTIES IN PROPORTION.)

RELIABLE ELECTRICAL SUPPLY CO., 236½ E. Madison St., CHICAGO.

Turkeys, Chrysanthemums, and Okonite

ARE

Timely Topics.

They are ALIKE in that each is a King.

King of Fowls—
King of Flowers—
King of Insulations.

They are NOT ALIKE in that Okonite alone has a continuous reign.
But Okonite is not our only kingly specialty. We have:

Bryant Electric Specialties,
Perkins Electric Specialties,
Hart Electric Specialties,
Paiste Electric Specialties,
Anchor Electric Specialties,
And others.

Central Electric Company,

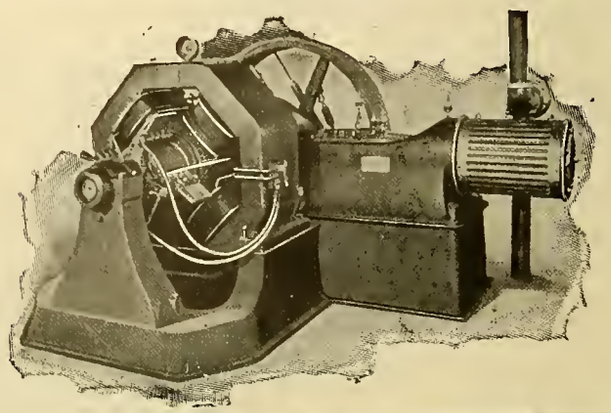
173-175 Adams Street,

CHICAGO.

Geo. A. McKinlock, President.
Charles E. Brown, Secretary.
S. R. Frezier, Treasurer.

EDDY GENERATORS.

Direct Connected or Belted for Electric Railways, Central Stations, Isolated Lighting or Power Plants.



Eddy Motors—Slow, Medium or High Speed.

We build all necessary apparatus for the transmission of Electrical Power through factory or other buildings.

The Eddy Electric Mfg. Co.,

WINDSOR, CONN.

NEW YORK, H. B. Coho & Co., Mail and Express Building.
PHILADELPHIA, Walter C. McIntire & Co., 506 Commerce St.
BOSTON, G. M. Angier & Co., 64 Federal St.
ELMIRA, S. N. Blake.
ST. LOUIS, Western Electrical Supply Co.
KANSAS CITY, W. T. Osborn.
CINCINNATI, O., Nevada Bldg., John A. Stewart.
CHICAGO, 305 Dearborn St., Wallace & Hine, Managers.
SAN FRANCISCO, CAL., Cal. Elec. Wks., 409 Market St.

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Holmes Fibre-Graphite Co.
Partridge Carbon Co.

Burglar Alarms.
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New York Ins. Wire Co
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Standard Underground C Co.
Washburn & Moen Mfg. Co.

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Partridge Carbon Co.
Reisinger, Hugo.
Schiff, Jordan & Co.
Washington Carbon Co.

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Boiler Expurgator Co.
Central Electric Co.
California Asphalt Co.
Commercial El. Supply Co.
Electric Appliance Co.
Mass. Chemical Co.
McLennan & Co., K.
Okonite Co.
Reliable Elec. Supply Co.
Standard Elec. Const. Co.

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Sargent & Lundy.
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Warren Electric Mf g. Co.

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General Electric Co.
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Northern Electl. Mfg. Co.
Peoples Electric Co.
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Sargent & Lundy.
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Wagner Elec. Mfg. Co.
Warren Electric Mfg. Co.
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Simplex Electrical Co.
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Washburn & Moen Mfg. Co.

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Int. Correspond. Schools.

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Commercial El. Supply Co.
Electric Appliance Co.
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Point Marion Mfg. Co.
Reliable Elec. Supply Co.

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Paiste Co., H. T.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Reliable Elec. Supply Co.
Wagner Elec. Mfg. Co.
Westinghouse El. & Mfg. Co.

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Hobart Elec. Mfg. Co.
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Nott & Co., A. D.
Roth Bros. & Co.
Sargent & Lundy.
United Elec. Imp. Co.
Wagner Elec. Mfg. Co.
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Westinghouse El. & Mfg. Co.
Wright, Wm.

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Fuel Economizer Co.

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Central Electric Co.
Globe Electric Heating Co.

Electric Meters.
American El. Meter Co.
Zsmel Arc Light Meter Co.

Electric Railways.
General Electric Co.
Westinghouse El. & Mfg. Co.

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Bain, Foree.
McRae, A. L.
Sargent & Lundy.

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Central Electric Co.
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Keystone El. Instrument Co.
Mankowitz, Sam'l.
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Queen & Co.
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Wagner Elec. Mfg. Co.
Weston Electrical Inst. Co.

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Nott & Co., A. D.
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Otto Gas Engine Wks.
Prouty Co., The.
Van Horne, Burger & Co.

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Westinghouse El. & Mfg. Co.

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Davis & Son, I. B.

Fibre.
Delaware Hard Fibre Co.
Diamond State Fibre Co.
Kartsvert Mfg. Co.

Files.
Barnett Co., G. & H.
Central Electric Co.

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Central Electric Co.
Commercial El. Supply Co.

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Stow Mfg. Co.

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D. & W. Fuse Co.

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Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.

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Link-Belt Machinery Co.
Peerless Rubber Mfg. Co
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Link-Belt Machinery Co.

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Central Electric Co.
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Commercial El. Supply Co.
Electric Appliance Co.
Farr Tel. & Cons. Sup. Co.
General Electric Co.
Hodge, Walsh & Loring.
Hill, W. S. Electric Co.
K. & W. Company.
Mankowitz, Sam'l.
McKinlock & Camp, Agts.
Ohio Electric Works.
Paiste Co., H. T.
Partrick & Carter Co.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Reliable Elec. Supply Co.
Western Electric Co.

Globes and Electrical Glassware.
Central Electric Co.
Commercial El. Supply Co.
Wheeler Reflector Co.

Gov'nors, Water Wheel.
Lombard Water Wheel Gv. Co.

Graphite Specialties.
Besly & Co., Chas. H.
Central Electric Co.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

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Central Electric Co.
Queen & Co.

Insulators and Insulating Materials.
Ansonia Electrical Co.
Brixey, W. R.
Bryant Electric Co.
California Asphalt Co.
Central Electric Co.
Chicago Edison Co.
Chicago Ins. Wire Co.
Commercial El. Supply Co.
Delaware Hard Fibre Co.
Dismond State Fibre Co.
Electric Appliance Co.
Emerson El. Mfg. Co.
Empire China Works.
Hill, W. S. Electric Co.
Kartsvert Mfg. Co.
K. & W. Company.
Locke, Fred. M.
Mankowitz, Sam'l.
Mass. Chemical Co.
Mica Insulator Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Paiste Co., H. T.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Phillips Insulated Wire Co.
Reliable Elec. Supply Co.
Simplex Electrical Co.
Standard Elec. Const. Co.
Standard Underground C. Co.
Wagner Elec. Mfg. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Chicago Edison Co.
Chicago Ins. Wire Co.
Commercial El. Supply Co.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Mankowitz, Sam'l.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Reliable Elec. Supply Co.
Simplex Electrical Co.
Standard Underground C. Co.
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Junction Boxes.
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Faries Mfg. Co.
Vought, M. I.

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Puritan Electric Co.

Lamps, Incandescent.
Buckeye Electric Co.
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Edison Lamp Dept.
Electric Appliance Co.
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Ohio Electric Works.
Reliable Elec. Supply Co.
Sawyer-Man Elec. Co.
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Electric Appliance Co.
General Electric Co.
Westinghouse El. & Mfg. Co.

Magnet Wire.
(See Insulated Wires.)

Mechanical Machinery.
Besly & Co., Chas. H.
Garvin Machine Co., The.
Link-Belt Machinery Co.
Robertson & Sons, Jas. L.
Stilwell-Bierce Smith-Valle.

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Commercial El. Supply Co.
Munsell & Co., Eugene.

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Link-Belt Machinery Co.
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American Engine Co.
Card Electric Co.
Central Electric Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hobart Elec. Mfg. Co.
Mankowitz, Sam'l.
Northern Electl. Mfg. Co.
Ohio Electric Works.
Peoples Electric Co.
Roth Bros. & Co.
Sargent & Lundy.
Stanley Elec. Mfg. Co.
Storey Motor & Tool Co.
United Elec. Imp. Co.
Wagner Elec. Mfg. Co.
Warner, Wm. F.
Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co.
Williams, J. P.
Wright, Wm.

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Besly & Co. Chas. H.
Garlock Packing Co.
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Pearless Rubber Mfg. Co.
Robertson & Sons, Jas. L.

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Mass. Chemical Co.

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Phosphor Bronze Sm. Co. Ltd.

Platinum.
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Lindsley Bros.
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Perrizo & Sons.
Point Marion Mfg. Co.

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Commercial El. Supply Co.
Electric Appliance Co.
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Swarts Metal Refining Co.

Reflectors.
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Wheeler Reflector Co.

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Hodge, Walsh & Loring.

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Commercial El. Supply Co.
Electric Appliance Co.
Moore, Alfred F.
New York Insulated Wire Co
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Reliable Elec. Supply Co.
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Brixey, W. R.
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No. 1110 PINE ST., ST. LOUIS, MO.,

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And everything we make is good.

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MICROPHONES GUARANTEED INDEFINITELY, and are the only ones that can be immersed in water for a month without impairing efficiency.

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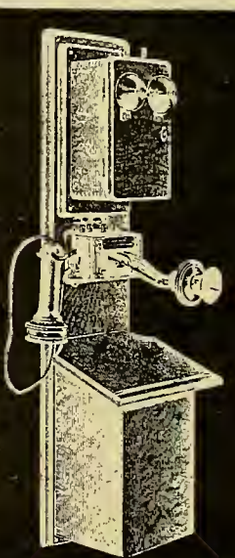
THAT TALK ANY DISTANCE



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SWITCHBOARDS rapid to operate. that don't "fall down" that don't inherit lawsuits.

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TOLL LINE **SYSTEMS** that R.up-to-date that never fail to work. that all calls must go to central

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Full line of intercommunicating private plant apparatus, Police, Fire Alarm, Railway System Equipment etc.

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Is Still Made and Sold by Us.

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The application of **ELECTRICITY** in every direction, during the past dozen years, is largely due to Westinghouse inventiveness and enterprise. ***Westinghouse Electric Apparatus is the Universal Standard.*** For whatever purpose electricity is used Westinghouse work gives the best results. We do not confine our efforts to huge affairs like the famous Niagara plant, or the 75,000 H. P. plant on the St. Lawrence, or the railway system which we exhibit at Pittsburgh, or the street railway plants which we have placed all over the country. We produce **EVERY KIND OF ELECTRIC APPARATUS.** Our Arc Lamps are the best in the world. Wurts Lightning Arresters are the only infallible protectors. Every electric plant in America needs them. Shallenberger Meters require nothing to be said in their favor. Everybody buys them, because it is useless to buy any other kind. Quick-break Switches; Switchboards that are models; Ammeters and Voltmeters that are exact; Motors for small machinery and fine tools.

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Chicago, April 30, 1896.

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As you are aware, the wire upon the wheel is very much exposed and the test will no doubt be a most severe one.

Yours very truly
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By L. V. Rice, Mgr.

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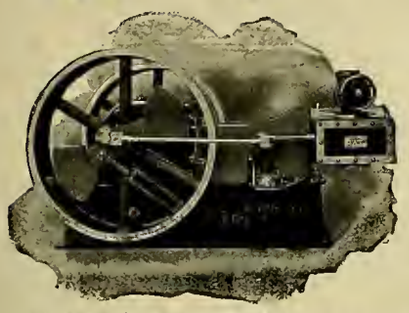
Features of Our Engines Worth Remembering:



1st—A symmetrical design with an intelligent, scientific distribution of metal, giving exceptional strength and perfect balance.
2nd—The only absolutely steam-tight valve, which automatically adjusts itself for wear, needing no outside attention.
3rd—"Rites governor system," which combines the greatest simplicity with most perfect regulation.
4th—Crank shaft forged open-hearth high-carbon steel, combining greatest strength, best wearing qualities and smoothest surface.
5th—Most complete automatic oiling system.

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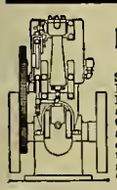
FOOS Gas and Gasoline Engines EXCEL ALL OTHERS IN DESIRABLE FEATURES.
Adapted for ALL Power Purposes—Electric Lighting, Milling, Mining, Water Works, Elevators, Factories, etc. Cheaper and Better than Steam.
2 to 250 H. P. Write Before Purchasing. FOOS GAS ENGINE CO., Springfield, O.



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2 to 50 H. P.
Runs without smoke, odor or noise. Special styles for Electric Lighting, Boats, Mining Locomotives, Hoists, Portable, Threshing, Pumping, Farm and Dairies, Inspection and Street Cars, Road-Wagons, Printing Offices and all stationary purposes. All engines guaranteed and may be returned at our expense if not as represented. THE PROUTY CO., 79 Dearborn St., CHICAGO, U.S.A.

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$1.00 EACH.
ELECTRICIAN PUB. CO.,
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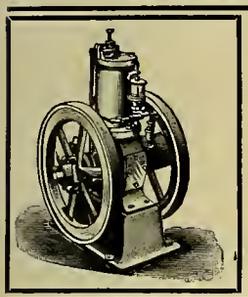

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Electric Lighting,
Economical Power.
POWER WITH EVERY STROKE OF THE PISTON.
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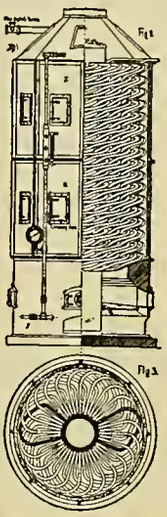

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BROOKLYN, N. Y.
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BUILT IN UNITS OF 50 TO 1,000 H. P.
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ALSO BUILDERS OF
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Specifications, Drawings and Prices furnished on application.
Send for Catalogue of Climax and Compound Boilers.

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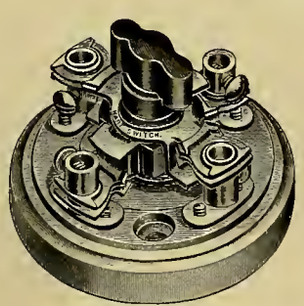
Of information, for practical men, is contained in our Catalogue "C." Write for one if you are not already supplied. Page 7 reads as follows:

10 AMPERE 4-WAY OR COMMUTATION SWITCH.



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Dimensions the same as No. 21 Switch.

Price each, $1.35.

Bases open or closed. Packed six in a box.

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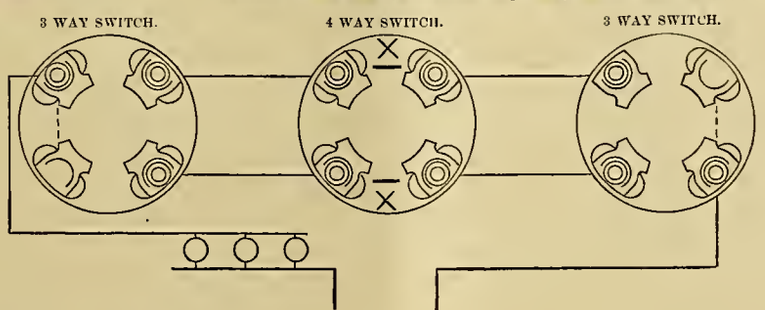
It is necessary that the wires indicated should be connected to the binding posts at the ends of the lines on the four-way base, shown below at ××.



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All genuine Hart Switches have the words "Hart Switch" stamped in the metal. Look for the stamp.

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THE NEW AMERICAN TURBINE
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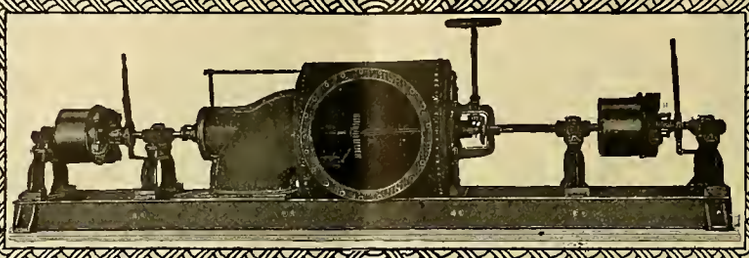

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7,000 WHEELS NOW RUNNING Filling every condition of service in a most efficient and satisfactory way.

ELECTRIC POWER TRANSMISSION. Pelton Wheels are especially adapted to this purpose and are operating the majority of stations of this character in all parts of the world. Highest efficiency and best regulation guaranteed. Catalogues furnished on application. Address

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WATER WHEELS

For Heads of 3 Feet to 2000 Feet.
Especially adapted to all kinds of
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Recent tests at Holyoke, given below, enable us to guarantee: *The Largest Power ever obtained from a wheel of the same diameter. The highest speed ever obtained for the same power. The highest mean efficiency when running from half to full gate.* We guarantee also: *A runner of the greatest possible strength. A gate unequaled in quickness and ease of opening and closing.*

Test of a 45 in. SAMSON, Jan. 25, 97.						Test of a 35 inch SAMSON, Feb.1,'97.					
Gate Open.	Head.	Rev. Pr. Min.	Cu. Ft. Pr. Sec.	Horse Power.	Per Cent.	Gate Open.	Head.	Rev. Pr. Min.	Cu. Ft. Pr. Sec.	Horse Power.	Per Cent.
Full	15.00	144.00	172.69	240.97	82.03	Full	15.29	194 25	102.02	143.44	81.08
⅞	15.04	138.12	155.03	223.61	84 55	⅞	16.56	187.75	92.15	146.73	84.78
¾	15.11	127.67	133.24	191.06	83.68	¾	17.33	178.50	83.95	138.40	83.88
⅝	15.88	131.50	112.65	162.80	80.25	⅝	17.54	176.40	68.82	109.64	80.09
½	16.47	126.87	90.04	127.73	75.95	½	17.68	168.50	57.69	88.14	76.19

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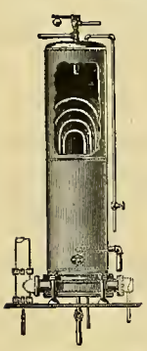

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Provided with U-shaped Tubes, it Never Leaks.

THE HIGHEST GRADE ONLY.

Our catalogue contains the representative names of a large number of contented buyers of **BERRYMAN HEATERS** built by us in the last twenty years. A copy awaits your order at any time.

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Is guaranteed to prevent slipping and to preserve the leather.
It will pay you to send for circulars and testimonials.

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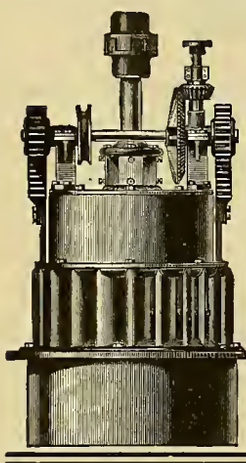

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TURBINE.

On Vertical or Horizontal Shaft,
Especially Adapted for Electrical Work.

Gives more power per diameter with a higher percentage of useful effect than any other water-wheel heretofore made. All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with us, **as we are willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.**

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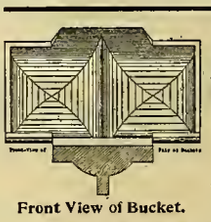
Estimates furnished for complete power plants and results guaranteed.



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Cazin Water Wheel.

Pat. March 16, 1897.

Will furnish more power per cubic foot of water used than any other wheel made.

Can be Operated by Steam at Periods of Low Water.

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— DELTA METAL —
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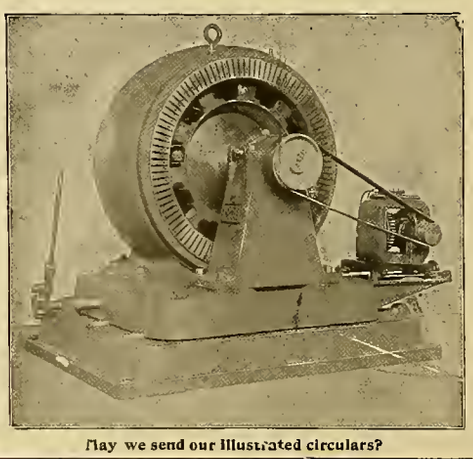
ORIGINAL AND SOLE MAKERS IN THE U.S.

Makes No Noise, Makes Money.



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The Circular Frame of the Warren Dynamo

Is cast STEEL, the base and sur-base cast iron. THE SHAFT IS WROUGHT, HAMMERED STEEL. The annular openings at the ends of frame are covered with an ornamental grille permitting a perfect circulation of air through interior of machine.

THE BEARINGS ARE LARGE and SELF-OILING, provided with large reservoirs. Dynamo needs no attention except the usual dusting and wiping off that every careful, neat engineer gives to the machinery in his charge.

NO REPAIRS. NO BRUSHES. NO COMMUTATOR.

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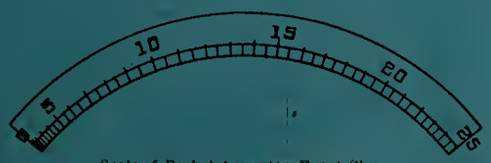

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AN ACCURATE ALTERNATING
INSTRUMENT THAT CAN ALSO BE USED FOR
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LONG SCALE.
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INDISPENSABLE FOR
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THE SMALL STATION MANAGER,
THE PRACTICAL ELECTRICIAN.
MADE TO WITHSTAND ROUGH USAGE.
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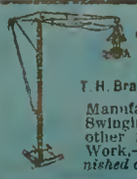

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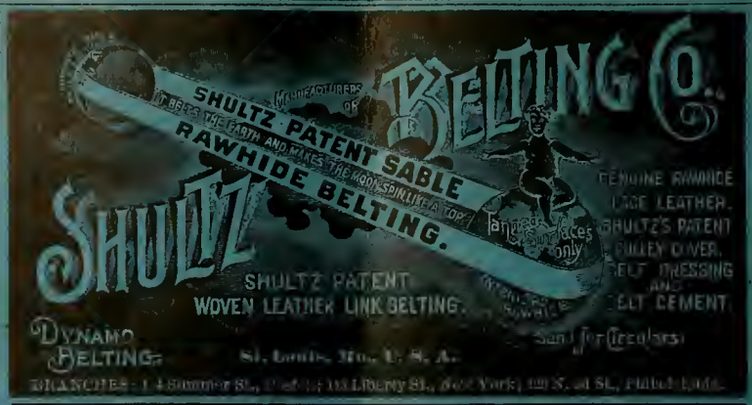
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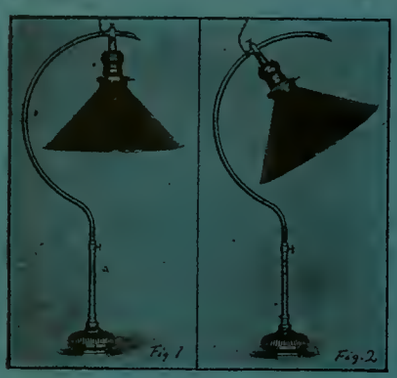
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Fig. 2

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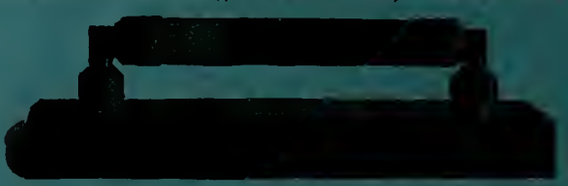

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Vol. XXI. CHICAGO, DECEMBER 4, 1897. No. 23

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Alcatraz Electrical Compound.

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For Series and Multiple Lighting of any Candle Power or Voltage, adapted to Fit any Standard Socket.

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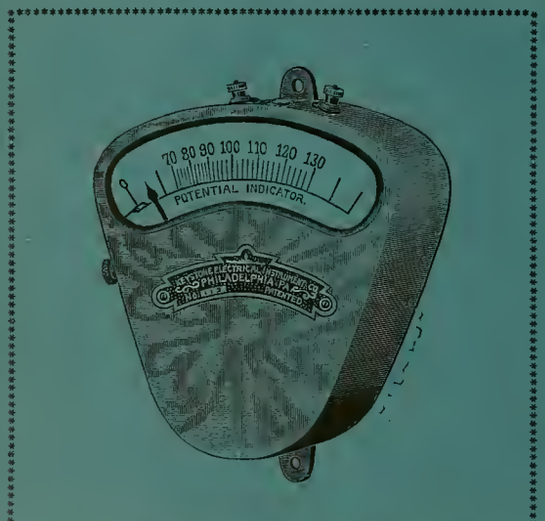

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Our Instruments are constant and durable, sensitive and accurate, pleasing in appearance and always correct.

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ARC LAMPS.

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AMERICAN CARBON CO.'S Plain and Coated

CARBONS FOR SERIES ARC LIGHTING.

GENERAL WESTERN AGENTS.

HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

Chicago Edison Co.,

DEALERS IN ELECTRIC LIGHTING SUPPLIES,

139 Adams Street, CHICAGO.

The American Electric Meter Co.,

9th St. and Montgomery Ave., Philadelphia, Pa.,

Is now prepared to take orders for early delivery of all sizes of 3-Wire Constant Potential Registering Meters.

This meter is calibrated ready for instant use.
This meter requires no knowledge of electricity to erect.
This meter shows the load passing every instant.
This meter is hermetically sealed.
This meter measures correctly with uneven loads.
This meter can be calibrated with a watch in six minutes.
This meter requires no lubrication.
This meter is magnetically shielded.
This meter is direct reading, having no multiplier.
This meter does not require one-thousandth of a horse power.
This meter will operate for years without opening.
This meter has no springs, jewels or frictional errors.
This meter once right is always right.

- - THE - -

BRYANT-PAISTE SWITCH.

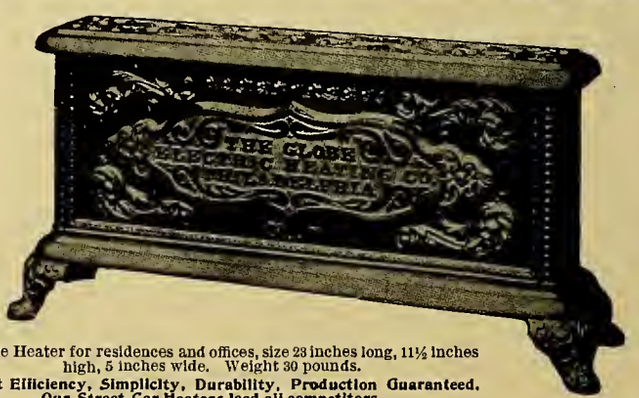
PRICES GREATLY REDUCED.

WRITE YOUR JOBBER FOR REVISED FIGURES.

THE BRYANT ELECTRIC CO.,

BRIDGEPORT, CONN. CHICAGO, ILL.

ELECTRIC HEATERS AVAILABLE TO ALL. MINIMUM EXPENSE.



Portable Heater for residences and offices, size 23 inches long, 11½ inches high, 5 inches wide. Weight 30 pounds.

Highest Efficiency, Simplicity, Durability, Production Guaranteed. Our Street Car Heaters lead all competitors.

Send for new illustrated circular.

Heating coils renewed like incandescent lamps. Constructed for any voltage. Work on direct or alternating current. Consumes 6. 8 amperes on 110 volt current, 1. 5 on 500 volt current.

THE GLOBE ELECTRIC HEATING CO., 147 North 12th Street, Philadelphia, Pa.

SEE THESE PRICES!

Weatherproof Wire, all sizes to No. 8, per lb	$0.13¾
Rubber-covered Wire, No. 14, per 1,000 feet	7.50
Shaffer-Paiste Rosettes, concealed or cleat, each	.05¾
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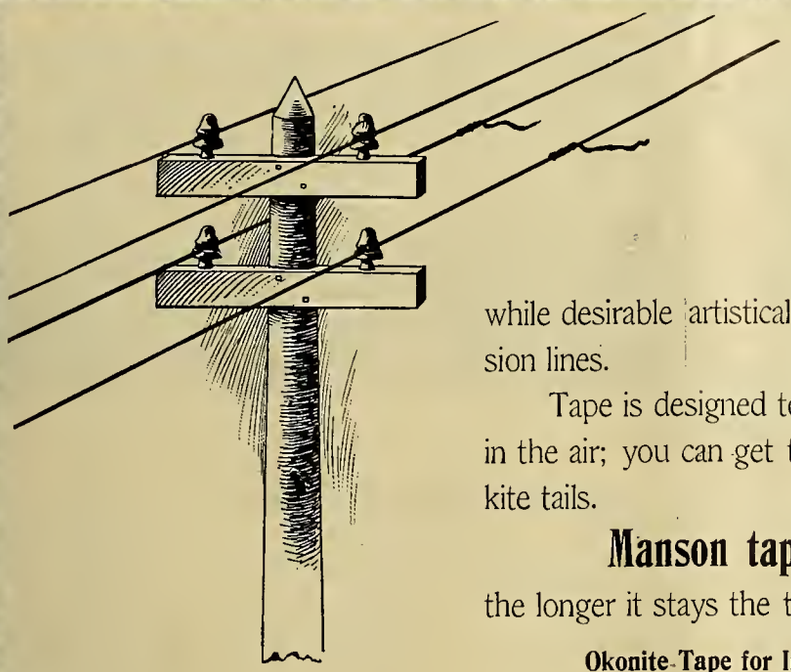
Dry Batteries, each	.18
Metal Push Buttons	.09

(OTHER SPECIALTIES IN PROPORTION.)

RELIABLE ELECTRICAL SUPPLY CO., 236½ E. Madison St., CHICAGO.



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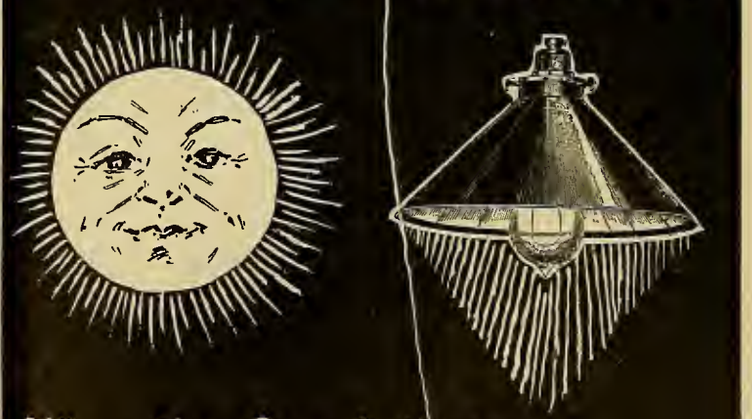

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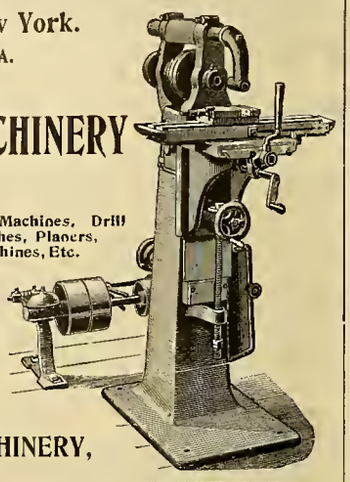

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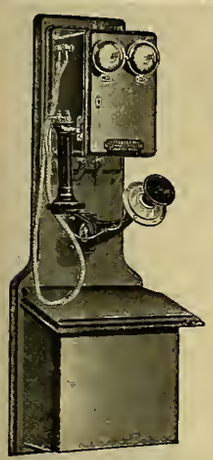

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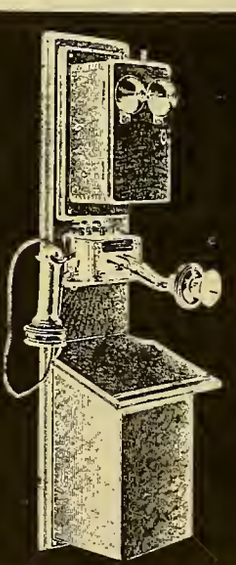

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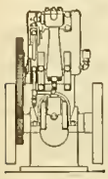

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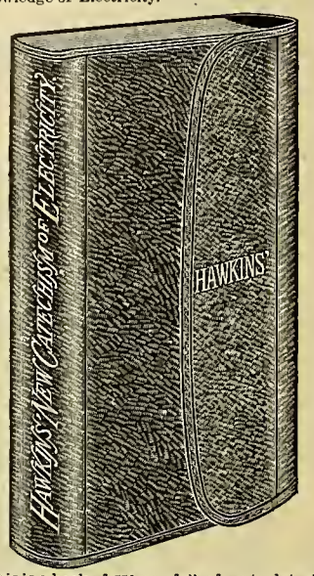

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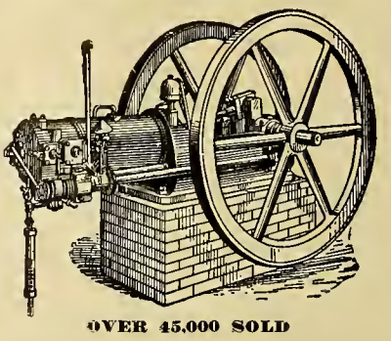

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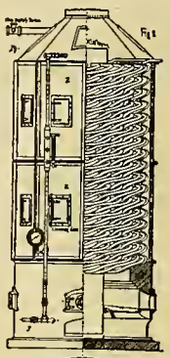

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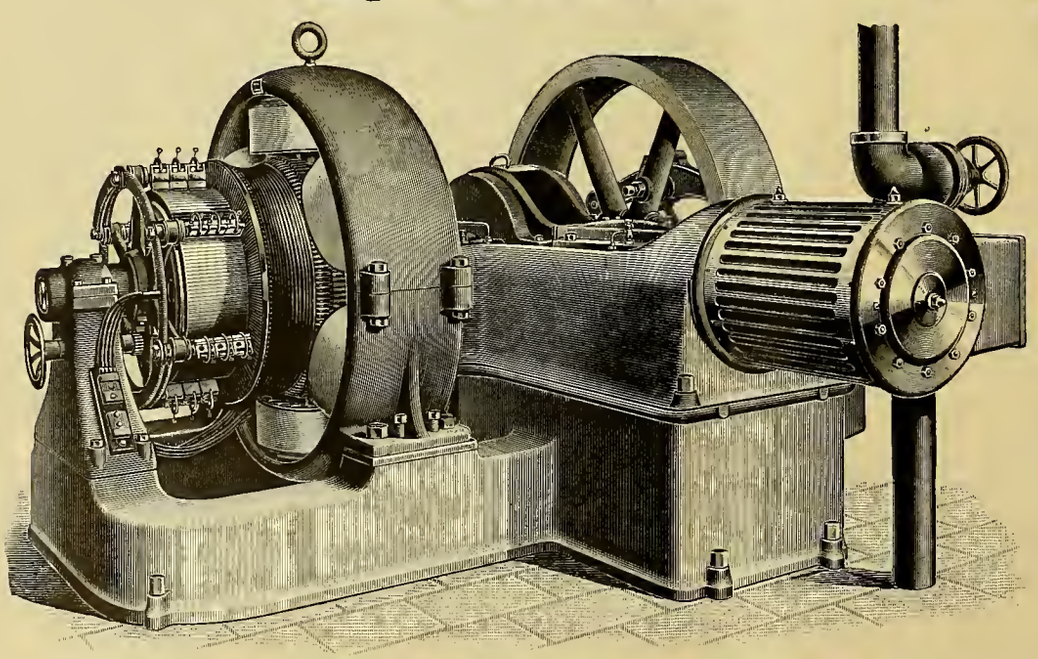

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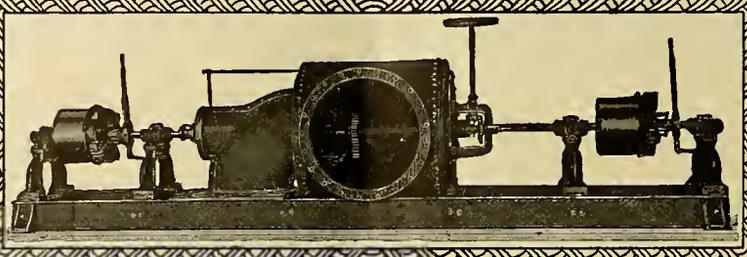

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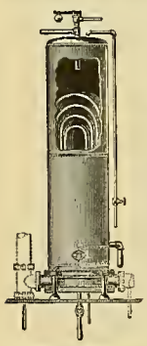

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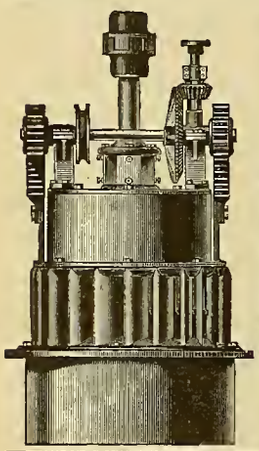

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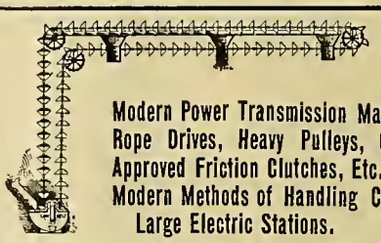

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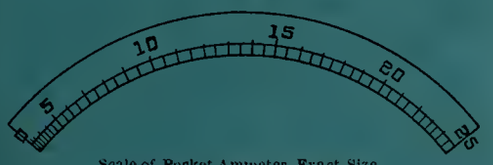

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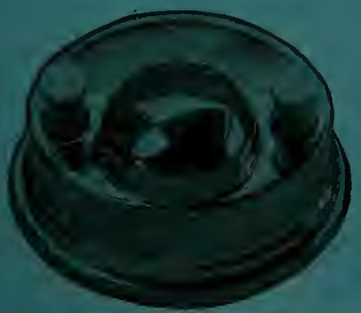

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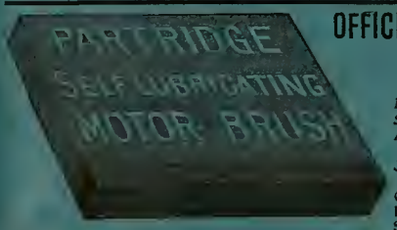

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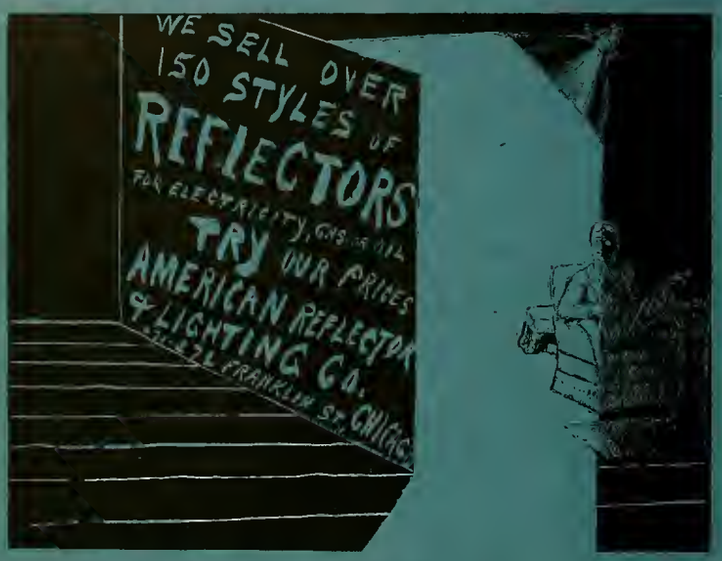

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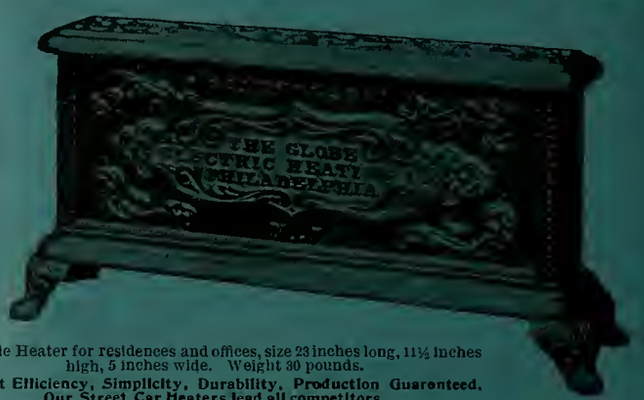

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HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

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A HIGH-GRADE BATTERY AT A FAIR PRICE.

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Specially constructed for all open circuit work; will guarantee it is beyond comparison with any other cell for

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Give it a trial, be convinced and begin to save money on battery account. A comparative test with any other battery will prove above statement correct.

Please write for Prices and Trade Discounts.

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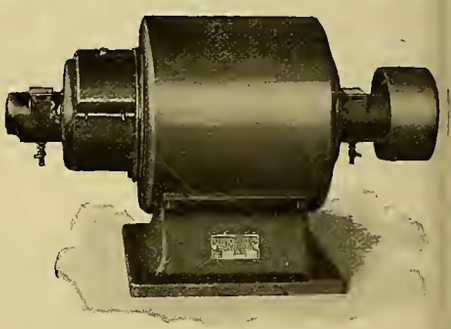

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Specially Adapted for Direct Connection to Machinery.

Special Direct Current Motors for All Classes of Work.

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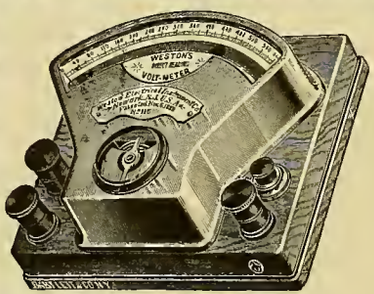

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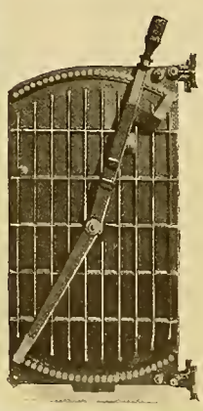

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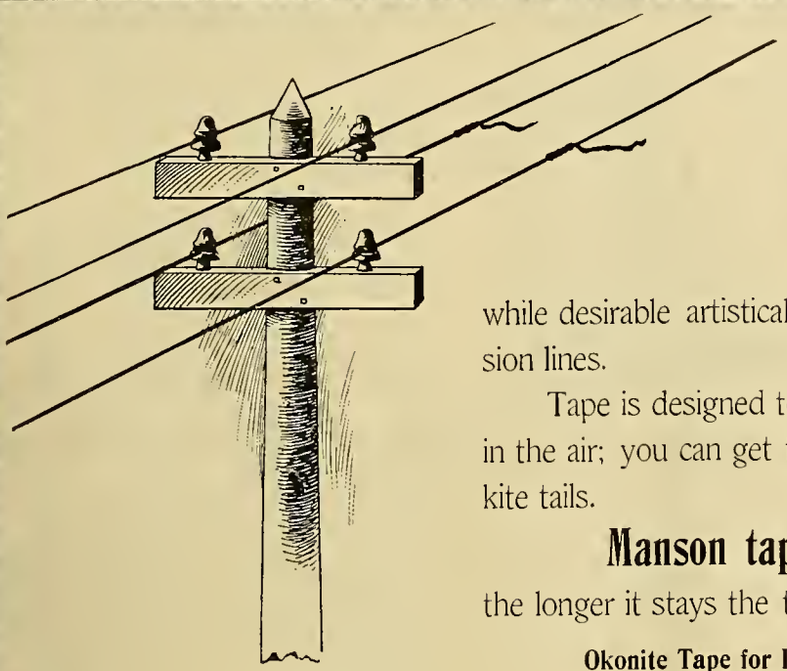

That waving effect,

while desirable artistically, is deplorable when applied to transmission lines.

Tape is designed to insulate and protect joints, not to wave in the air; you can get the "wavy effect," if desired, by migratory kite tails.

Manson tape sticks and stays stuck;

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BOLD, BRAVE, STOUT, RESOLUTE, INTREPID, and this well defines the

Hardy Incandescent Lamp

And the company that makes it.

BOLD in asserting that the lamp is the best made.
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TO PROVE IT we will send you by express, charges prepaid, a dozen 16 C.-P. lamps, any base, any voltage, from 45 V. to 125 V., for $2.16. Agents wanted. Write for prices.

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Incandescent Lamps and Electrical Supplies,
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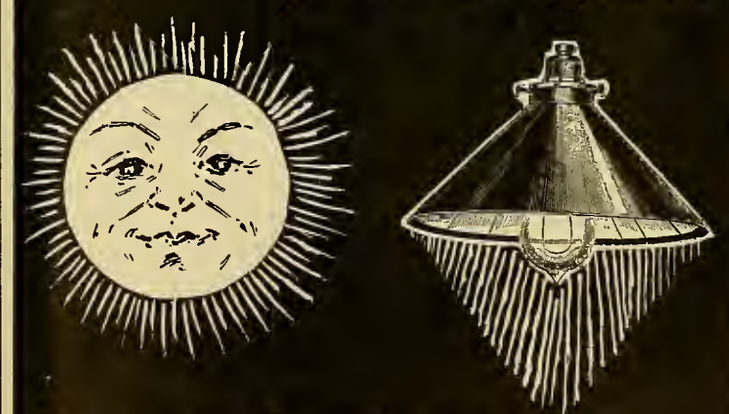
THE SUN & ITS PROXY!



When the Sun fails you

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Over 200 Styles Reflectors, and Shades.
Electric, Gas, & Oil.
Wheeler Reflector Co.
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Perfection Drop Elevator Annunciators.

NEVER FAIL TO WORK.

Are not affected by jars.

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Diffuses light uniformly.
Easily attached and detached.
Can be cleaned without removal and are practically indestructible.
Made for all styles of arc lamps.
Send for descriptive circular and prices.
Will give exclusive agency to responsible house in principal cities.

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Mitchell Temp. Copper Co.

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Electric Appliance Co.
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Mankowitz, Sam'l.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
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Farr Tel. & Cons. Sup. Co.
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Emerson El. Mfg. Co.
General Elec. Co.
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K. & W. Company.
Mankowitz, Sam'l.
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Peoples Electric Co.
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Central Electric Co.
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Sargent & Lundy.
United Elec. Imp. Co.
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Warren Electric Mfg. Co.
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Nott & Co., A. D.
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American Engine Co.
Ball Engine Co.

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Emerson El. Mfg. Co.
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Stow Mfg. Co.

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Commercial El. Supply Co.
Electric Appliance Co.

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Peerless Rubber Mfg. Co.
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Partrick & Carter Co.

Gears.
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Central Electric Co.
Link-Belt Machinery Co.

General Elec. Supplies.
Ansonia Electrical Co.
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Chicago Edison Co.
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Electric Appliance Co.
General Electric Co.
Hodge, Walsh & Loring.
Hill, W. S. Electric Co.
K. & W. Company.
Mankowitz, Sam'l.
McKinlock & Camp, Agts.
Ohio Electric Works.
Palste Co., H. T.
Partrick & Carter Co.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Reliable Elec. Supply Co.

Globes and Electrical Glassware.
Central Electric Co.
Commercial El. Supply Co.
Wheeler Reflector Co.

Gov'nors, Water Wheel.
Lombard Water Wheel Gv. Co.

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Central Electric Co.
Dixon Crucible Co., Jos.
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K. & W. Company.

Induction Coils.
Central Electric Co.
Queen & Co.

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Bryant Electric Co.
California Asphalt Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Crouse-Hinds Elec. Co.
Delaware Hard Fibre Co.
Diamond State Fibre Co.
Electric Appliance Co.
Emerson El. Mfg. Co.
Empire China Works.
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Mass. Chemical Co.
Mica Insulator Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Palste Co., H. T.
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Phillips Insulated Wire Co.
Reliable Elec. Supply Co.
Simplex Electrical Co.
Standard Underground C. Co.
Wagner Elec. Mfg. Co.

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Chicago Edison Co.
Chicago Ins. Wire Co.
Commercial El. Supply Co.
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Electric Appliance Co.
General Electric Co.
Mankowitz, Sam'l.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Reliable Elec. Supply Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

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Bossert Elec. Const. Co.

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K. & W. Company.
Lynn Incandescent Lp. Co.
Meysenburg & Badt
Reliable Elec. Supply Co.
Sawyer-Man Elec. Co.
United Elec. Imp. Co.
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General Electric Co.
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Stilwell-Bierce Smith-Vaile.

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Commercial El. Supply Co.
Muosell & Co., Eugene.

Mining Apparatus, Elec.
General Electric Co.
Link-Belt Machinery Co.
Westinghouse El. & Mfg. Co.

Motors.
American Engine Co.
Card Electric Co.
Central Electric Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hobart Elec. Mfg. Co.
Mankowitz, Sam'l.
Northern Electl. Mfg. Co.
Ohio Electric Works.
Peoples Electric Co.
Roth Bros. & Co.
Sargent & Lundy.
Stanley Elec. Mfg. Co.
Storey Motor & Tool Co.
United Elec. Imp. Co.
Wagner Elec. Mfg. Co.
Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co.
Williams, J. P.
Wright, Wm.

Packing.
Besly & Co. Chas. H.
Garlock Packing Co.
Link-Belt Machinery Co.
Peerless Rubber Mfg. Co.
Robertson & Sons, Jas. L.

Paints.
California Asphalt Co.
Central Electric Co.
Commercial El. Supply Co.
Mass. Chemical Co.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co. Ltd.

Platinum.
Baker & Co.

Poles.
Central Mfg. Co.
Lindsley Bros.
National Tube Works Co.
Perrine & Sons.
Point Marion Mfg. Co.
Stone Lumber Co.

Porcelain.
Bryant Electric Co.
Central Electric Co.
Commercial El. Supply Co.
Empire China Works.
Peru Elec. Mfg. Co.

Radiators.
Shadowless Radiator Mfg. Co.

Refiners.
Swarts Metal Refining Co.

Reflectors.
Amer. Reflector & Ltg. Co.
Shadowless Radiator Mfg. Co.
Wheeler Reflector Co.

Re-Winding—Repairs.
Central Electric Co.
Chicago Edison Co.
Electrical Exchange, The.
Elliott, W. H. Elec. Co.
Hodge, Walsh & Loring.

Rheostats.
American Rheostat Co.
Central Electric Co.
Cutler-Hammer Mfg. Co.
General Electric Co.
Iron Clad Rheostat Co.
Leonard, Ward, Elec. Co.
Meysenburg & Badt.
Westinghouse El. & Mfg. Co.

Second-Hand Machin'y.
Coraman Co.
Electrical Exchange, The.
Elliott, W. H. Elec. Co.
Hodge, Walsh & Loring.
Holmes, Pyott & Co.
Wright, Wm.

Shades.
Amer. Reflector & Ltg. Co.
Central Electric Co.
Wheeler Reflector Co.

Spark Arresters.
K. & W. Company.

Speaking Tubes.
Central Electric Co.
Electric Appliance Co.
Partrick & Carter Co.

Speed Indicators.
Besly & Co., Chas. H.
Central Electric Co.
Keystone El. Instrument Co.
Queen & Co.
Robertson & Sons, Jas. L.
Weston Electrical Inst. Co.

Steel Boxes.
Bossert Elec. Const. Co.

Steel Pipe.
National Tube Works Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Willard El. & Battery Co.

Tapes, Insulating.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Chicago Ins. Wire Co.
Commercial El. Supply Co.
Electric Appliance Co.
Moore, Alfred F.
New York Insulated Wire Co
Okonite Co., The.
Reliable Elec. Supply Co.
Simplex Electrical Co.
Washburn & Moen Mfg. Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Central Tel. & Elec. Co.
Commercial El. Supply Co
Farr Tel. & Cons. Sup. Co.
Kokomo Tel. & El. Mfg. Co.
Kusel, D. A., Tel. & El. Mfg. Co.
Lockwood T. & T. Co. of Am.
Mo. Tel. Mfg. Co.
N. W. Tel. Mfg. Co.
Rawson Electric Co.
Standard Tel. & El. Co.
Stromberg-Carlson Tl. M. Co.
Taber & Mayer.
Viaduct Mfg. Co.
Western Tel. Cons. Co.

Transformers.
Central Electric Co.
Commercial El. Supply Co.
Diamond Elec. Co.
Ft. Wayne Elec. Corporation
General Electric Co.
Roth Bros. & Co.
Stanley Electric Mfg. Co.
Wagner Elec. Mfg. Co.
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Central Electric Co.
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General Electric Co.
Westinghouse El. & Mfg. Co.

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Am. Impulse Wheel Co.
Dayton Globe Iron Works Co
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Wire, Bare.
Besly & Co., Chas. H.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Standard Underground C. Co
Washburn & Moen Mfg. Co.

X Ray Outfits.
Central Electric Co.
Commercial El. Supply Co.
Edison Lamp Dept.
Queen & Co.

For Alphabetical Index of Advertisements See Page III.

IMPROVED ENCLOSED ARC LAMPS

OF THE

Highest Development in Mechanical and Electrical Design.

For Constant Potential Circuits. Simplest Feeding Mechanism.

Best Device for Trimming and Cleaning Inner Globe, Reducing Breakage of Inner Globes to a Minimum.

Outdoor Lamps Equipped With Reflectors.

Finished in Many New and Handsome Styles, as follows:

Oxidized Copper Bronze Finish, Oxidized Brass, Ebony Finish, Gold Lacquer Iridescent Finish, Antique Finish.

All Indoor Lamps Equipped With Switches.

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Main Office and Works: Elizabethport, New Jersey.

WM. F. BOSSERT, Pres. H. P. CROUSE, V.-Pres. FRANK G. SCOFIELD, Sec'y and Treas.

Send for Catalogue "D." **UTICA, N. Y.**

ELECTRIC APPLIANCE COMPANY, Chicago, General Western Agents.

ABSOLUTELY HIGHEST GRADE

CARBONS

(Made in Vienna and Nuremberg)
FOR DIRECT AND ALTERNATING CURRENT.
SPECIAL CARBONS FOR 150-HOUR ARC LAMPS.

SCHIFF, JORDAN & CO.,
OF VIENNA, AUSTRIA,
232-234 GREENWICH ST., N.Y.

RALPH STRASCHNOW GENL. MGR.
L.E. FRORUP - GENL. SALES AGT.

WRITE FOR PRICE LIST AND SAMPLES.

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AD. STUDIO.

"Gladys"

—A Sun-kissed Violet.

Commercial Electrical Supply Co.,

ST. LOUIS.

CARBONS

FOR ENCLOSED LONG-BURNING ARC LAMPS.

"ELECTRA"

FOR DIRECT CURRENT ARC-LAMPS

FOR ALTERNATING CURRENT ARC-LAMPS

ELECTRA ELECTRA

HIGHEST GRADE NUERNBERG CARBONS

UNEQUALLED IN QUALITY AND EFFICIENCY

ABSOLUTELY STEADY AND BRILLIANT LIGHT.

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WHEN YOU BUY A MOTOR see that you get an **AMERICAN** Rheostat with it.

Our Rheostats are unsurpassed either in workmanship or general finish throughout, and operate more satisfactorily than others.

WRITE US FOR CIRCULARS AND PRICES OF OUR

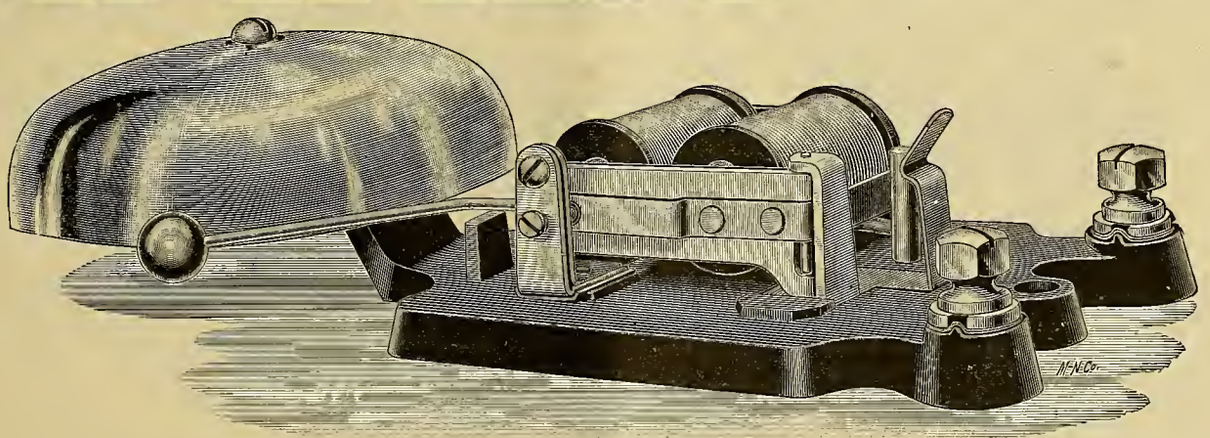
Automatic Motor Starters,
Field Regulators,
Speed Controllers,
Elevator Controllers,
Crane Controllers,
Automatic Overload Starters,
Pump Controllers,

RHEOSTATS FOR ANY PURPOSE.

American Rheostat Co., Milwaukee, Wis.

MARLO IRON BOX BELL.

Cannot Get Out of Adjustment.



(PATENTS PENDING.)
The engraving illustrates the bell full size and without cover.

Gong cannot turn or loosen, and therefore always remains in right striking position for hammer.

Contact post and screw once in adjustment **MUST** always remain so. No bothersome checknut.

Armature pivoted on brass pin in brass supports, giving free, positive movement. No wabbling, sticking or magnetizing.

Adjusting and contact spring is made of one piece **PHOSPHOR-BRONZE,** spring giving a positive double adjustment and perfectly balanced armature movement.

Slotted binding posts. Riveted contacts and all iron parts and screws copper plated.

If your supply house does not carry the **MARLO** in stock, write us, and we will give you the names of those in your vicinity that do, or we will be pleased to fill your order direct.

PROCTOR-RAYMOND MFG. CO., 444 Niagara St., BUFFALO, N. Y.

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The lately organized Sprague Electric Co. has taken up its permanent abode in the

Commercial Cable Bldg., 20 and 22 Broad St.,

From whence will shortly issue catalogues, circulars, pictorial, diagrammatic and other announcements concerning the wares of the

SPRAGUE ELECTRIC ELEVATOR CO.,

And the

Interior Conduit & Insulation Co.,

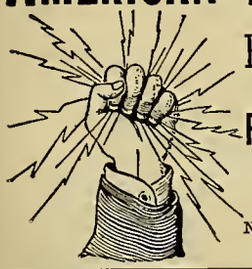
As well as of certain lines of new electric work which the company has secured the control of and which it is preparing to put upon the market with all possible dispatch.

Inquiries as to Interior conduits and Lundell motors should be addressed to the INTERIOR CONDUIT & INSULATION CO., 20 and 22 Broad Street, New York, and inquiries as to Sprague Electric Elevators, the new Lundell Dynamos, or in respect to Sprague's new system of Multiple Unit Railway Control, should be addressed to SPRAGUE ELECTRIC CO., 20 and 22 Broad Street, New York.

EUGENE F. PHILLIPS, Prest. F. N. PHILLIPS, Treas. W. H. SAWYER, Secy.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



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ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
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CHICAGO STORE, F. E. Donohoe, 241 Madison St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.

THE ONLY
WATER-WHEEL GOVERNOR
THAT GOVERNS.

WATERVILLE & FAIRFIELD RAILWAY & LIGHT CO.,
WATERVILLE, ME., Jan. 18, 1896.

Lombard Water-Wheel Governor Co., Boston, Mass.

GENTLEMEN:—In regard to your Type C governor, which is regulating for us our two Hercules Wheels, which give power to operate our Light Plant, Street R. R. and Power Generator, we are frank to admit that the machine does its work admirably. We have no hesitancy in recommending it to those in want of a governor.

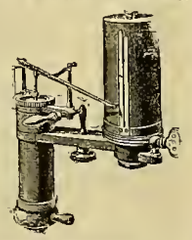
(Signed)
I. C. LIBBY, President Waterville & Fairfield R. R. & L. Co.

LOMBARD WATER-WHEEL GOVERNOR CO.,
61 Hampshire St., BOSTON, MASS.

The Handsomest

Pack of playing cards are sent to everyone sending us two 5-lb. or one 10-lb. labels cut from the front of "Eureka" Packing boxes. An artist's model posed for the JOKER; the ace and backs are special designs. You know "Eureka." It's better than any other. Try Eureka

• INDICATORS. •



If we can afford to sell you on very easy terms, can't you afford to buy? Send for catalogue and installment terms. We have twenty-five other high grade specialties.

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PHILADELPHIA.
Switchboard Instruments
For Central Stations and Isolated Plants.
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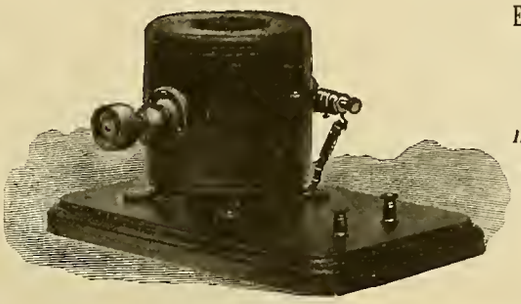
Chicago, 1440 Monadnock Bldg

Forée Bain,
Consulting Engineer,
Electricity, Mechanics,
Solicitor of Patents
Expert in patent causes.
Suite 1657-59 Monadnock Bldg., - Chicago.

"Paragon" Power Motors.



Estimates Furnished for Small Motors and Motor-Dynamos.

Iron Clad; No External Magnetism; Dust and Moisture Proof.

$\frac{1}{12}$, $\frac{1}{8}$, $\frac{1}{6}$, $\frac{1}{4}$, $\frac{1}{2}$ and 1 horse power.

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Steel Dynamos and Motors, 8, 15, 20, 35, 50, 100, 200, 300 and 500-light machines. $\frac{1}{2}$, 1, 2, 3, 5, 10, 15, 30 and 50 h. p. motors. State what you want and get our prices before ordering.

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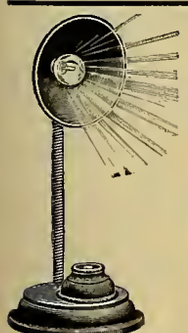
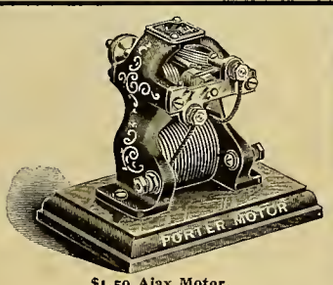


$1.50 Battery Lamp. Used with dry batteries.



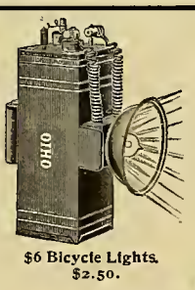
$1.50 Ajax Motor.

Necktie Light.

Dollar Motor.

Scarf Pin.

We are headquarters for the goods that pay the profit. Send for prices to the trade, and our new catalogue, just issued. We want agents.



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$1.50 Student Lamp. For acid or storage battery.

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Competent house and outside wireman; also must understand trimming lamps and keeping them in repair. Steady work for right man. Address, stating experience and reference,

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Winders direct from T.-H. and Westinghouse shops. Work guaranteed. Ten years' experience. Light plants installed complete. Send for prices.

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Six new 50-light 110 volt dynamos, compound wound; sliding bases. Guaranteed first-class. $85 each, cash.

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One A-30 T.-H. Alternator 1,000 v. Ironclad Armature with Exciter and Switchboard, with all instruments complete. One 45 k. w. Standard Generator 500 v. Compound Wound. One 15 h.-p. 500 V Detroit motor. One 15 h.-p. 500 V Commercial motor. One 50 light 1,200 c. p. Arc Dynamo Standard. One 30 light 1,200 c. p. Arc Dynamo Sperry. WILLIAM WRIGHT, 939 Monadnock Building, Chicago.

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Removes all Impurities.

ENTIRELY PREVENTS SCALE IN STEAM BOILERS. Catalogue on Application.

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All modern conveniences; rooms en suite; private baths; excellent cuisine. For transient and resident guests. Coolest and cleanest place in the city. Atmosphere of home.

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Direct current dynamos of 350, 700, 725, 800, 810, 900, 1,075, 1,330, 1,610 and 2,500 lights capacity.
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Engines, 50, 75, 85, 100, 115, 125, 150, 175 and 200 h. p.
Boilers, 100, 250, 375 and 500 h. p.
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Pumps, all sizes.

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Second hand Arc Lamps of different manufacture; good as new and thoroughly tested; also, Arc and Incandescent Dynamos and other electrical apparatus.

Always in the market for scrap Dynamos, Motors, Wire, Copper, burned out Incandescent Lamps and Lamp bases, etc. Address THE CORNMAN COMPANY, 1134 Hamilton St., Cleveland, Ohio.

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ELECTRICAL BULLETIN.

The Largest and Best Lot of Bargains in Electrical Merchandise Ever Offered.

The Electrical Exchange,
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A large handsome Map of the United States, mounted and suitable for office or home use, is issued by the Burlington Route. Copies will be mailed to any address on receipt of fifteen cents in postage by P. S. EUSTIS, Gen'l Pass. Agent, C., B. & Q. R. R., Chicago, Ill.

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For Lighting and Plating

5012 lights $30; 20 lights $50; lights $80; 70 lights $95; 100 lights $135; 200 lights $250.

MOTORS.

¼ h. p. $20; ½ h. p. $28; 1 h. p. $40; 2 h. p. $60.

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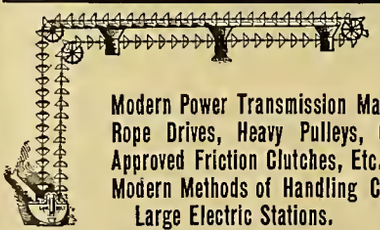

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Rope Drives, Heavy Pulleys, Gears and Fly Wheels,
Approved Friction Clutches, Etc.,
Modern Methods of Handling Coal in Power Plants and Large Electric Stations.

Designs and Estimates Submitted Promptly.

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ENGINEERS, FOUNDERS, MACHINISTS,
CHICAGO, U. S. A.

Scrap Copper Wire Wanted.

If you have any **Old Copper Wire** of any description to dispose of, it will pay you to communicate with us, as we are at all times in the market for any quantity of **Scrap Copper Wire**, at the highest market values. We pay cash and send prompt returns. We are also supplying the electrical trade with our high grade **Babbitt, Cotton Waste, Solder, Etc.** Please communicate with us.

SWARTS METAL REFINING CO.,
20 N. Desplaines Street, CHICAGO, ILL.

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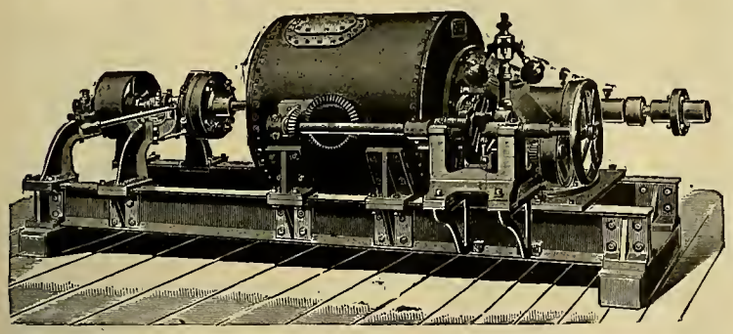
THE W. H. ELLIOTT ELECTRIC CO.,
14-16-18 MIDDLE ST.

CLEVELAND-O.

Victor Turbine Water Wheel.



Cylinder or Register Gate—Close Regulation and High Efficiency at Full and Partial Gate.

The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high speed and great efficiency and large capacity** for its **diameter,** being **double** the **power** of most wheels of the same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

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We are now prepared to furnish Victor Turbines, either single or in pairs, on horizontal shafts, and where the situation admits of their use we recommend them.

THE STILWELL-BIERCE & SMITH-VAILE CO., DAYTON, OHIO.

The Standard Open Circuit Batteries of the World.

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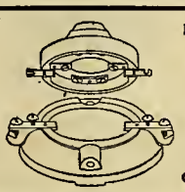
THE LECLANCHÉ BATTERY CO.,
111 to 117 East 131st St., N. Y.

WHITE CEDAR POLES And STREET CAR TIES.
Wholesale Producers.
PERRIZO & SONS, DAGGETT, MICH.

CEDAR LINDSLEY BROS., MENOMINEE, MICH., WHOLESALE PRODUCERS. **POLES**



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Cleat-Concealed-Combination-Sq. Base

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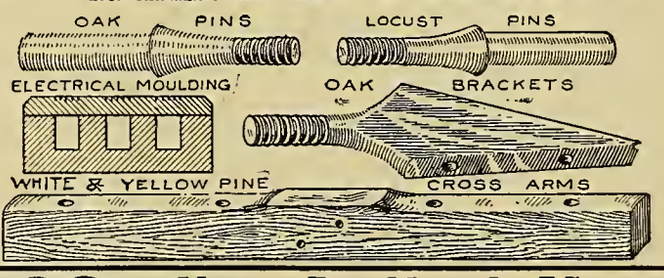

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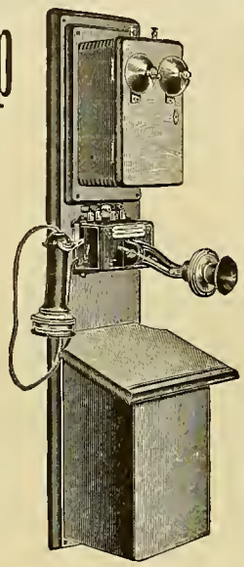

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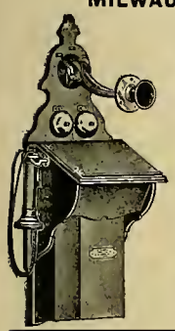

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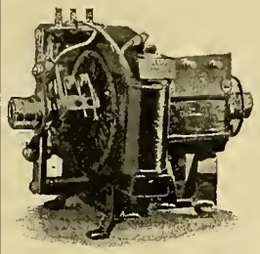

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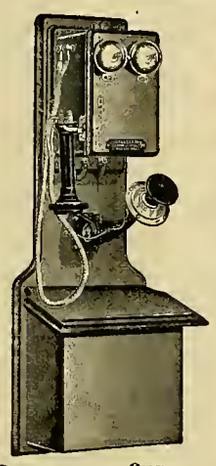

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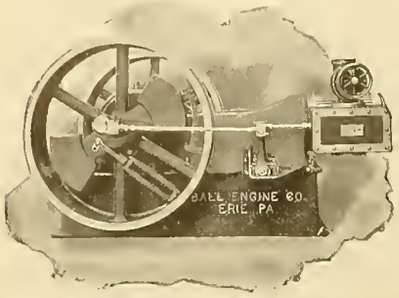

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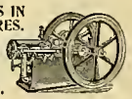

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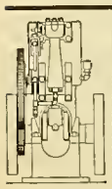

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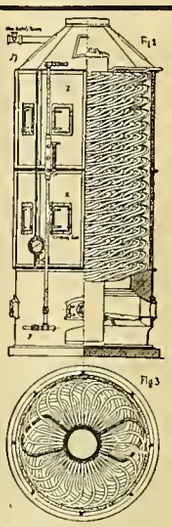

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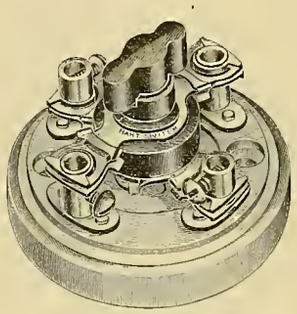

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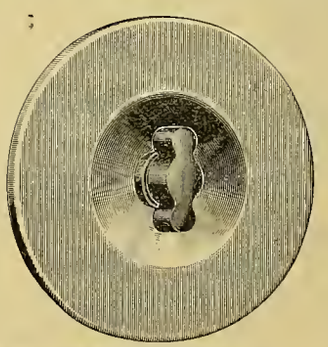

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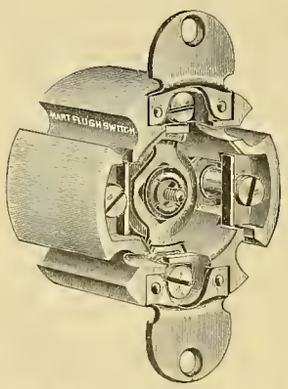

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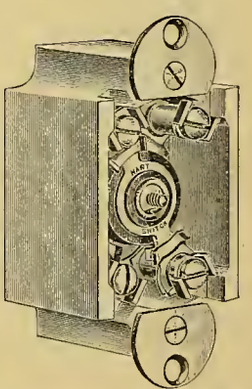

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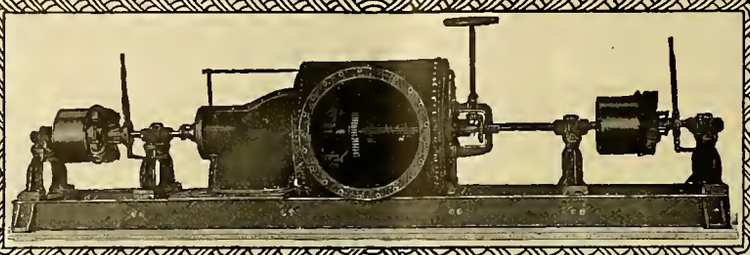

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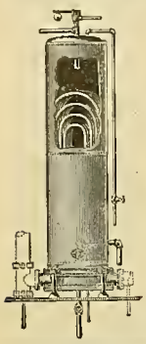

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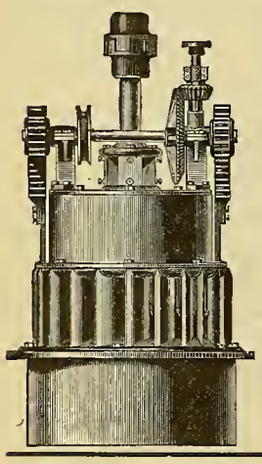

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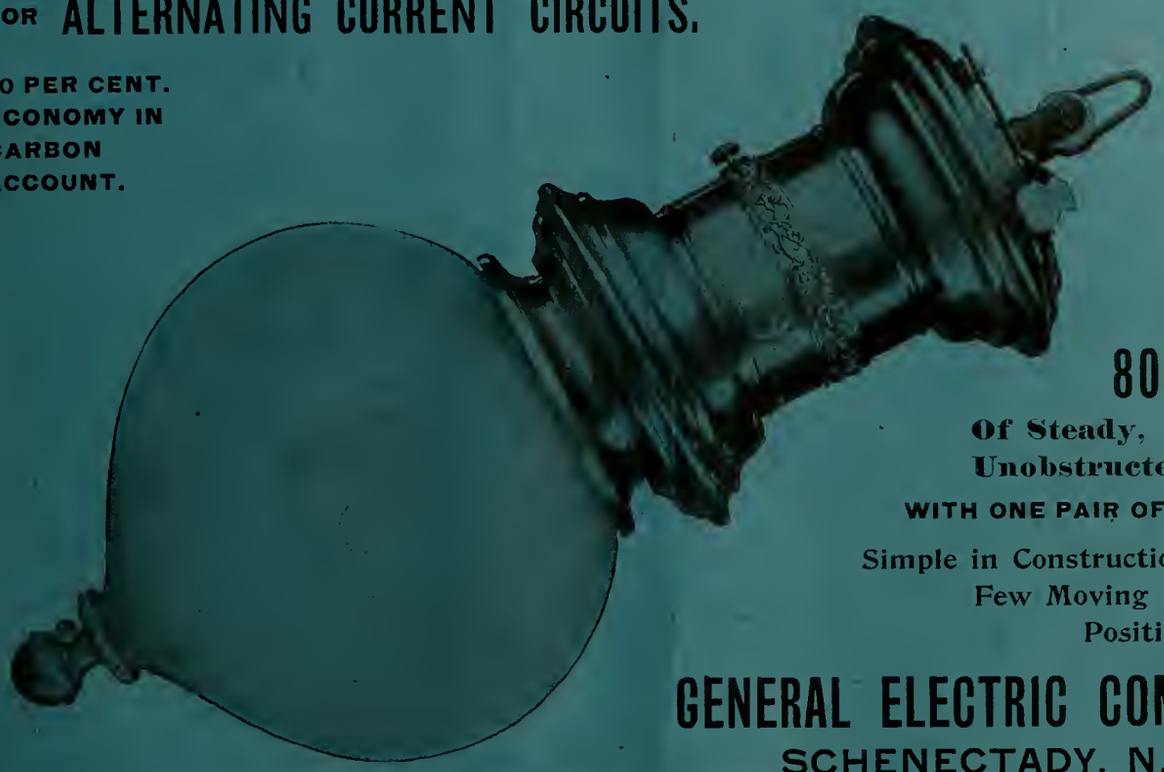

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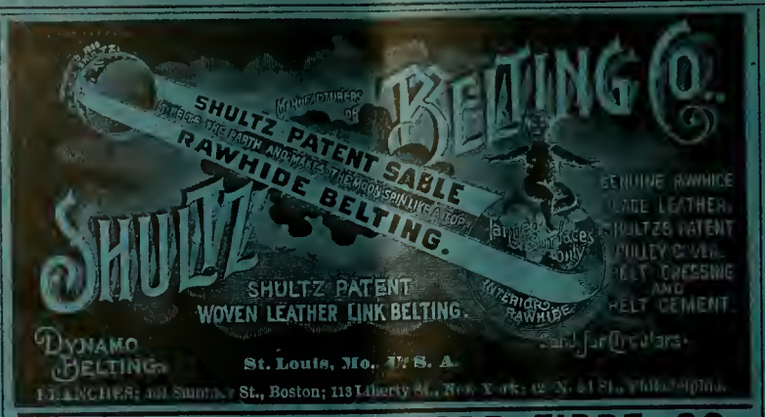

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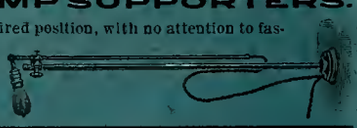

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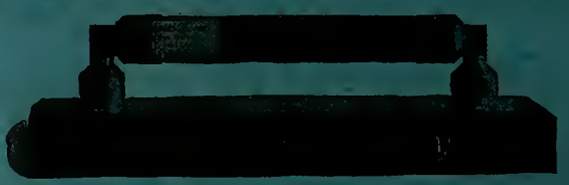

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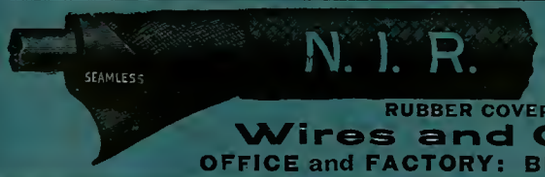

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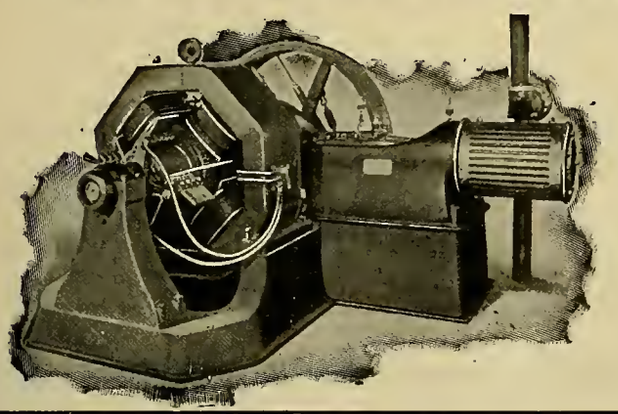

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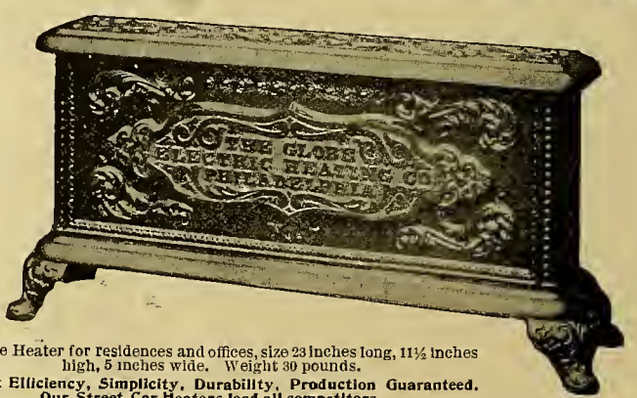

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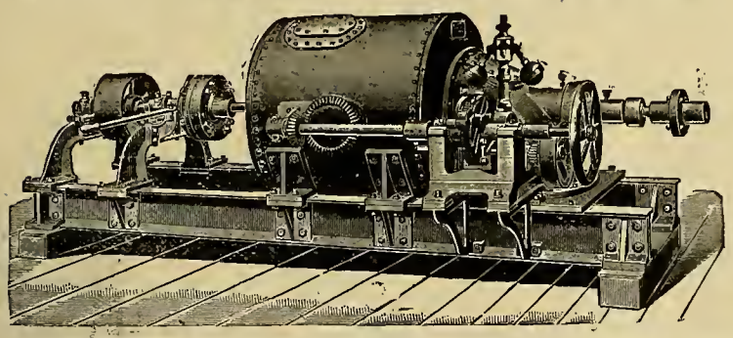

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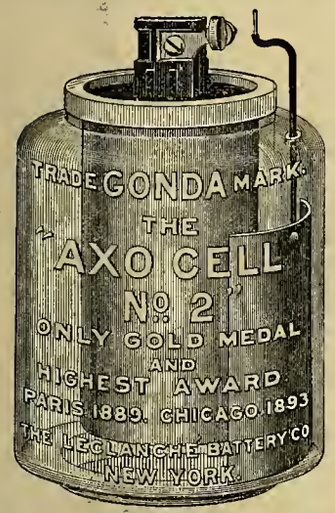

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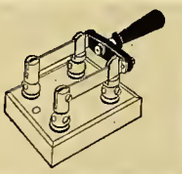

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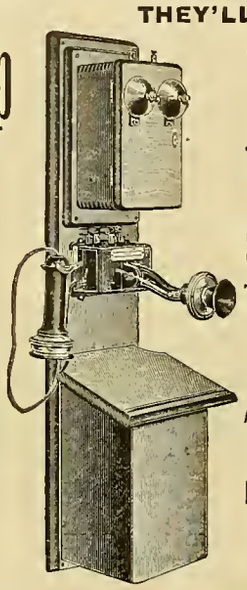

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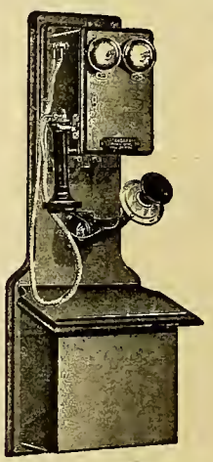

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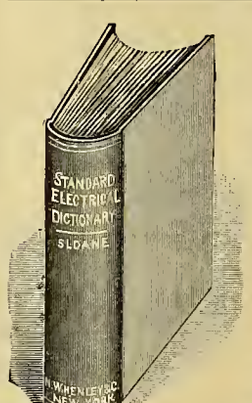

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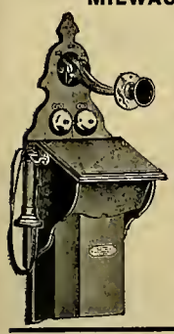

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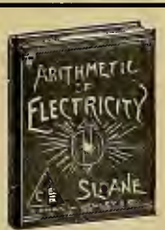

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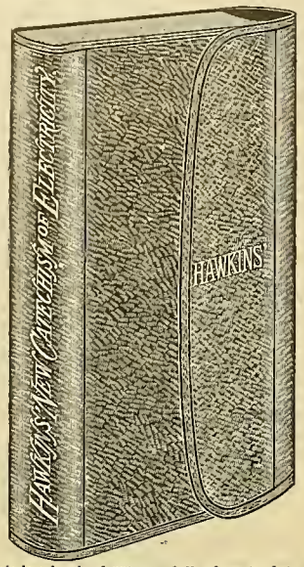

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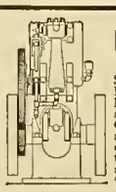

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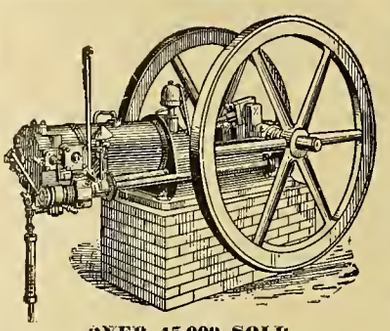

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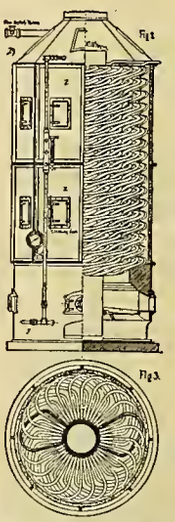

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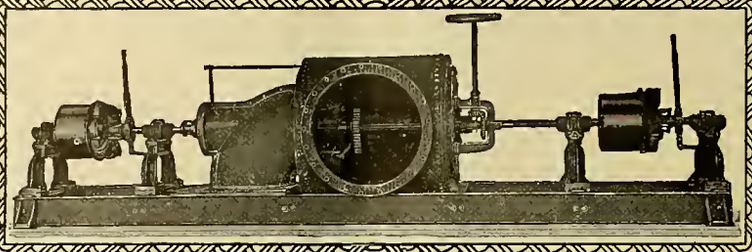

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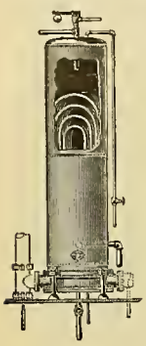

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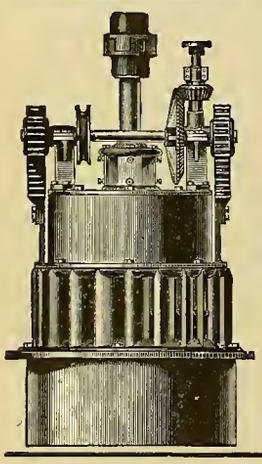

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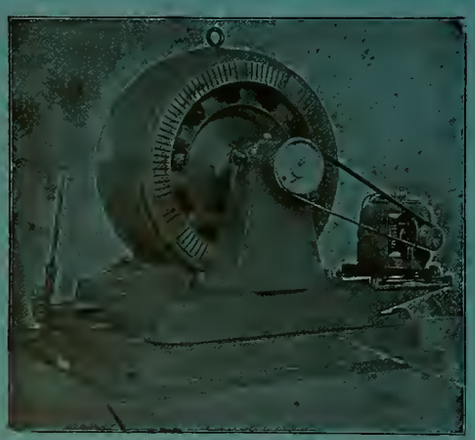

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HARDTMUTH CORED CARBONS for Direct and Alternating Current ARC LAMPS.

HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

AMERICAN CARBON CO.'S Plain and Coated CARBONS FOR SERIES ARC LIGHTING.

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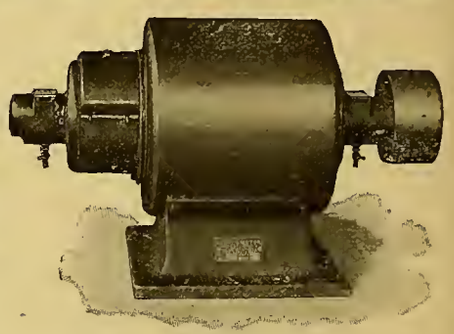

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Special Direct Current Motors for All Classes of Work.

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BRANCH FACTORY: Hamilton, Canada.

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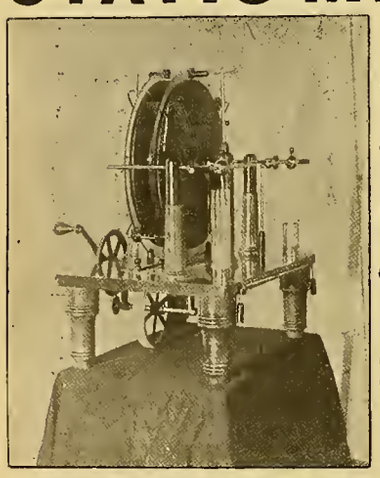

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Good Ventilation,
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Convenient to Install.

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No Commutator,
No Moving Wire,
Simplicity,
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Reliability,
Accuracy,
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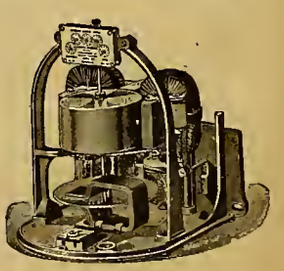

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NEVER FAIL TO WORK.

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Easily attached and detached.

Can be cleaned without removal and are practically indestructible.

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Send for descriptive circular and prices.

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Sipe & Sigler.

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General Electric Co.
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Wagner Elec. Mfg. Co.
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Peru Elec. Mfg. Co.
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Otto Gas Engine Wks.
Prouty Co. The.

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Kartavert Mfg. Co.

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Central Electric Co.
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Peerless Rubber Mfg. Co.
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Central Electric Co.
Partrick & Carter Co.

Gears.
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General Elec. Supplies.
Ansonia Electrical Co.
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Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Crouse-Hinds Elec. Co.
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General Electric Co.
Hodge, Walsh & Loring.
Hill, W. S. Electric Co.
K. & W. Company.
McKinlock & Camp, Agts.
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Partrick & Carter Co.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Reliable Elec. Supply Co.

Globes and Electrical Glassware.
Central Electric Co.
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Gov'nors, Water Wheel.
Lombard Water Wheel Gv. Co.

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Induction Coils.
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Queen & Co.

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Bryant Electric Co.
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Central Electric Co.
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Commercial El. Supply Co.
Crouse-Hinds Elec. Co.
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Emerson El. Mfg. Co.
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Hill, W. S. Electric Co.
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Mica Insulator Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Palste Co., H. T.
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Phillips Insulated Wire Co.
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Simplex Electrical Co.
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Commercial El. Supply Co.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
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Reliable Elec. Supply Co.
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Washburn & Moen Mfg. Co.

Junction Boxes.
Bossert Elec. Const. Co.

Lamp Adjusters.
Faries Mfg. Co.
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White Co., O. C.

Lamps, Alternating.
Puritan Electric Co.

Lamp Guards.
Wagor, P. R. & Co.

Lamps, Incandescent.
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Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Edison Lamp Dept.
Electric Appliance Co.
General Electric Co.,
K. & W. Company.
Lynn Incandescent Lp. Co.
Reliable Elec. Supply Co.
Sawyer-Man Elec. Co.
United Elec. Imp. Co.
Westinghouse El. & Mfg. Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Westinghouse El. & Mfg. Co.

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Link-Belt Machinery Co.
Robertson & Sons, Jas. L.
Stilwell-Bierce Smith-Valle.

Mica.
Central Electric Co.
Commercial El. Supply Co.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
General Electric Co.
Link-Belt Machinery Co.
Westinghouse El. & Mfg. Co.

Motors.
American Engine Co.
Card Electric Co.
Central Electric Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hobart Elec. Mfg. Co.
Northern Electl. Mfg. Co.
Ohio Electric Works.
Peoples Electric Co.
Roth Bros. & Co.
Sargent & Lundy.
Stanley Elec. Mfg. Co.
Storey Motor & Tool Co.
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Peerless Rubber Mfg. Co.
Robertson & Sons, Jas. L.

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California Asphalt Co.
Central Electric Co.
Commercial El. Supply Co.
Mass. Chemical Co.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co. Ltd.

Platinum.
Baker & Co.

Poles.
Berthold & Jennings.
Central Mfg. Co.
Lindsley Bros.
National Tube Works Co.
Perrizo & Sons.
Polot Marion Mfg. Co.
Stone Lumber Co.

Porcelain.
Bryant Electric Co.
Central Electric Co.
Commercial El. Supply Co.
Empire China Works.
Peru Elec. Mfg. Co.

Radiators.
Shadowless Radiator Mfg. Co.

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Swarts Metal Refining Co.

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Amer. Reflector & Ltg. Co.
Shadowless Radiator Mfg. Co.
Wheeler Reflector Co.

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Central Electric Co.
Chicago Edison Co.
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Hodge, Walsh & Loring.

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Chicago Ins. Wire Co.
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Electric Appliance Co.
Moore, Alfred F.
New York Insulated Wire Co
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Simplex Electrical Co.
Washburn & Moen Mfg. Co.

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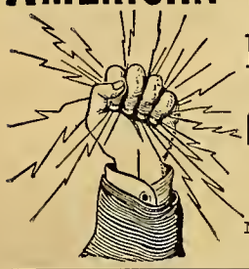

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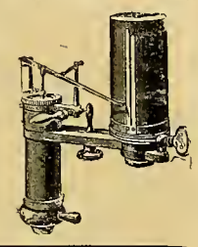

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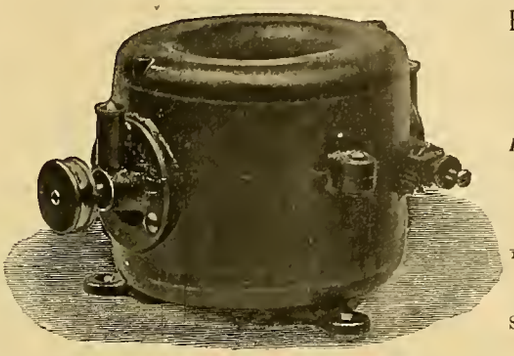

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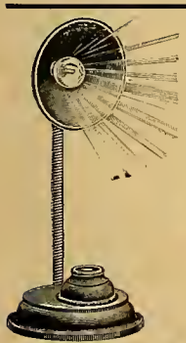

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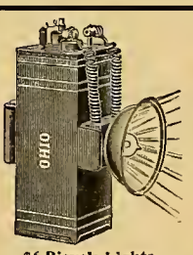

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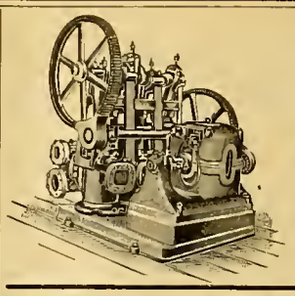

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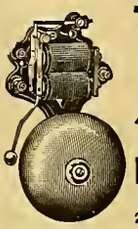

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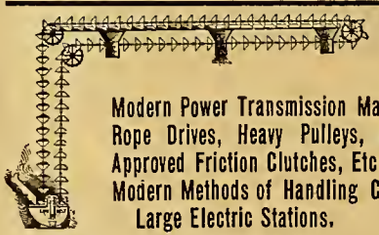

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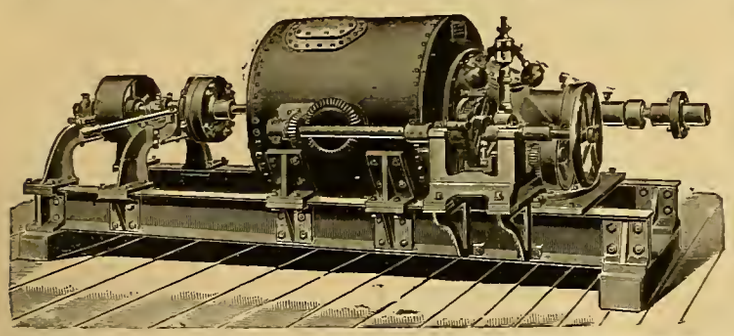

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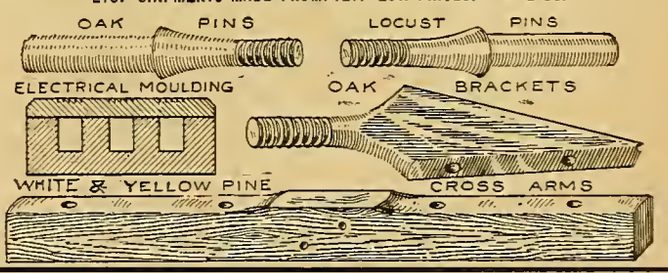

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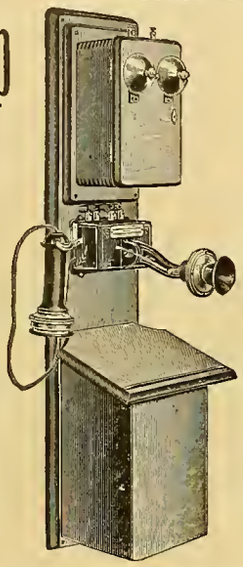

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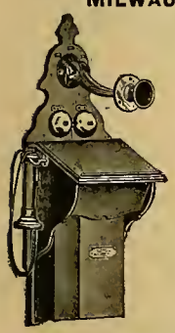

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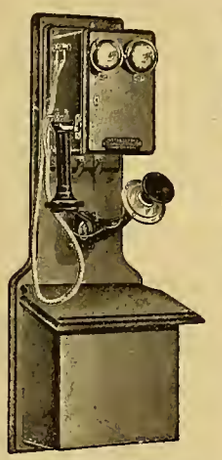

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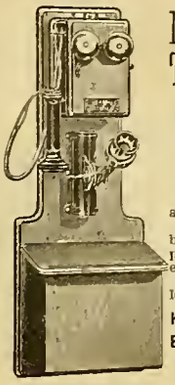

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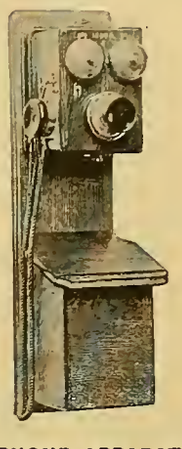

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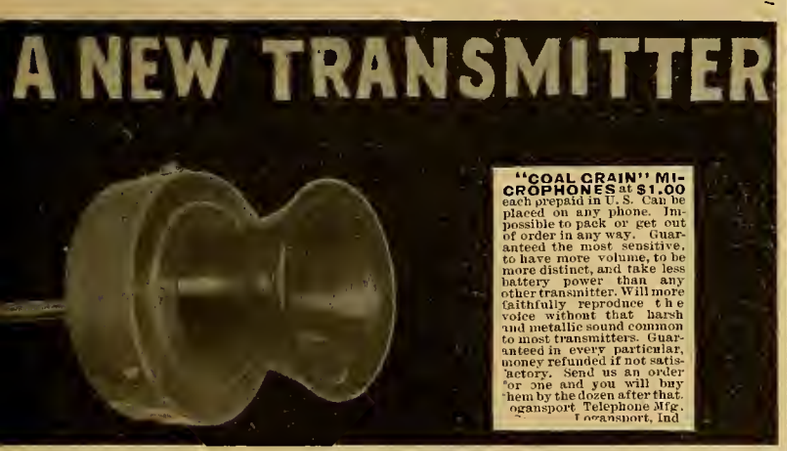

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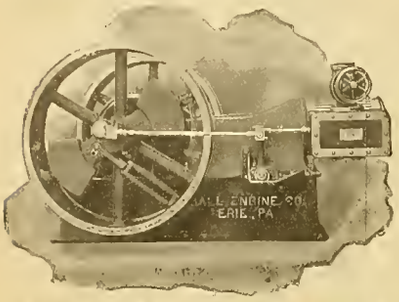

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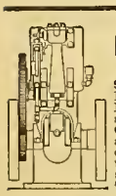

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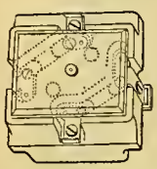

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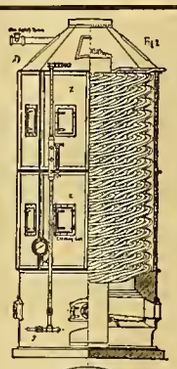

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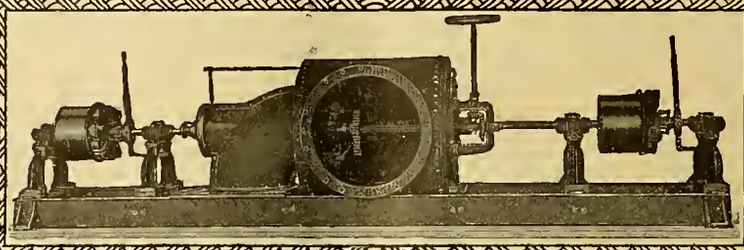

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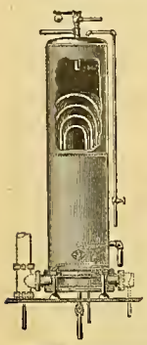

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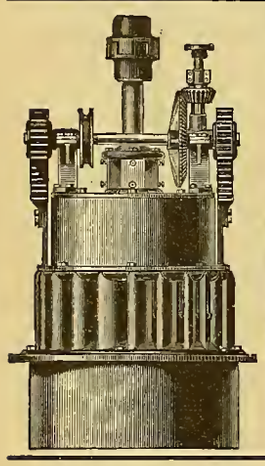

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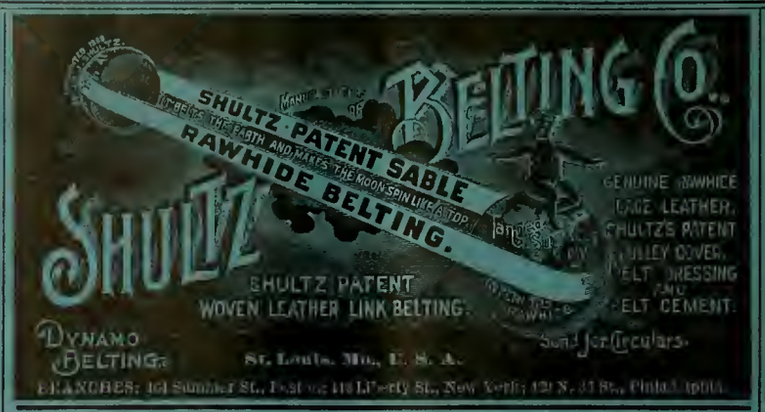

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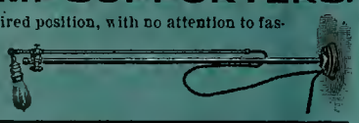

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